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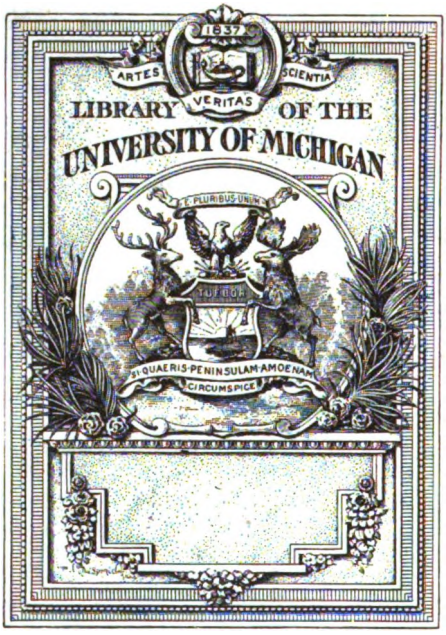
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Oregon State University. Agricultural Experiment Station

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OREGON

AGRICULTURAL

EXPERIMENT STATION,

BULLETIN No. 1.

History and Organization.

OCTOBER 1888.

CORVALLIS, OREGON:
"BOB'S PRINT," THE TIMES OFFICE.
1888.

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E. R. LAKE, M. S., Hortoculturalist and Botanist.
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History and Organization.

In accordance with a congressional act, commonly known as the "Agricultural College Act," the State Agricultural College of Oregon was temporarily located, in 1868, at Corvallis, Benton county, in connection with the Corvallis College.

By a subsequent act of the legislature, in 1870, the said Agricultural College was permanently located at Corvallis with the above-mentioned institution.

At that time there was but little interest manifested in scientific agriculture; and this lack of interest has, indeed, continued until very recently.

No provision has been made by the state for equiping the school with farm, buildings, apparatus, etc., but, in 1871, the citizens of Benton county purchased and gave to the college a farm of thirty-five acres, situated near Corvallis, for agricultural purposes. This is the present college farm.

From the time of its first location to the present the college has been carried on by an appropriation from the state, averaging a little over two thousand dollars annually, in addition to the interest accruing from the funds obtained by the sale of the college land donated by the state under the act of 1862. This has been consumed mostly from year to year in the current expenses of the college. The fund available for improvements, experiments and other work of such nature at no time had exceeded $1400 up to July 1st, 1887. This decided lack of interest in scientific agriculture and insufficient appropriations for work, other than the work of instruction in the class-room, has been no doubt due to the newness of the country; its great fertility; exceptionally fine climate, in the farming portion of the state, giving cer-

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tainty to crops; freedom from insect pests and the extensive tracts of grain and grazing lands to be occupied practically without cost.

In accordance with the act of the legislature of 1885 the State Agricultural College was relocated at Corvallis, Benton county, under certain provisions, the Corvallis College having first signified its intention and desire to relinquish the same to the state.

The provisions of relocation are contained in the following sections of the laws of Oregon:

SECTION 2678. That the permanent location of the State Agricultural College at Corvallis, Benton County, Oregon be, and the same is hereby ratified and confirmed; provided, however, that the citizens of said county shall, on or before the first day of January, 1889, have cause to be erected on the farm, containing thirty-five acres, in the immediate vicinity of said city, known as the agricultural College farm, brick buildings for the accommodations of the said State Agricultural College, at a cost of not less than $20,000; and provided further, that the said farm and building shall be, on or before the said first day of January, 1889, free from all liens and encumbrances whatever.

SECTION 2687. The board of regents provided for by this act shall be adpointed by the Governor during the present session of the legislature, but they shall not assume the government of said college until the building mentioned in the act shall have been completed, as aforesaid, and accepted by the Governor on behalf of the state.

All of the conditions of section 2678 had been fully complied with on July 2d, 1888, at which time the Governor duly accepted the college building provided for in said act.

The majority of the colleges endowed under the congressional act of 1862, including the Agricultural College of Oregon, did little or nothing by way of scientific investigation and experimentation respecting the principles and application of agricultural science. To supply a growing need, the act, commonly known as the "Hatch Act," provides for the establishment of Experiment Stations, was approved March 2, 1887, and reads as follows:

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THE HATCH ACT.

An Act to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of an act approved July second, eighteen hundred and sixty-two, and of the acts supplementary thereto.

Be it enacted in the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under direction of the college or colleges or agricultural department of colleges in each State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July second, eighteen hundred and sixty-two, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "agricultural experiment station:" *Provided*, that in any State or Territory in which two sueh colleges have been or may be so established the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the Legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner of agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important;

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and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said stations, annually, on or before the first day of February, to make to the governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States.

SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming as may request the same, and as far as the means of the station will permit. Such bulletins or reports and the annual reports of said stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster General may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the results as hereinbefore prescribed, the sum of fifteen thousand dollars per annum is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section eight of this act, out of any money in the Treasury proceeding from the sales of public lands, to be paid in equal quarterly payments, on the first day of January, April, July and October in each year, to the treasurer or other officer duly appointed by the governing boards of said colleges to receive the same, the first payment to be made on the first day of October, eighteen hundred and eighty-seven: *Provided, however*, That out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appropriation may be expended.

SEC. 6. That whenever it shall appear to the Secretary of the Treasury from the annual statement of receipts and expenditures of any of said stations that a portion of the preceeding annual appropriation remains unexpended, such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be construed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respetively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act and having also agricultural

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experiment stations established by law separate from said colleges, such States shall be authorized to apply such benefits to experiments at stations so established by such States; and in case any State shall have established, under the provisions of said act of July second aforesaid, an agricultural department or experimental station, in, connection with any university, college or institution not distinctly an agricultural college or school, and such State shall have established or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the Legislature of such State may apply in whole or in part the appropriation by this act made, to such separate agricultural college or school, and no Legislature shall by contract express or implied disable itself from so doing.

SEC. 9. That the grants of money authorized by this act are made subject to the legislative assent of the several States and Territories to the purposes of said grants: *Provided*, That payments of such instalments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its Legislature meeting next after the passage of this act shall be made upon the assent of the Governor thereof duly certified by the Secretary of the Treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payments from the Treasury to any or all the States or institutions mentioned in this act, but Congress may at any time amend, suspend, or repeal any or all the provisions of this act.

Approved, March 2, 1887.

It will be observed that the "Hatch Act" creates a department which is an integral part of, or co-ordinate with, the act of 1862, the latter creating a college of instruction, the former, that of experimentation.

Section 2 of the "Hatch Act" specifies the object and duty of the station which is so broad that it covers every department of agriculture; and therefore, every person engaged in agricultural pursuits of any sort, should consider that he has a just claim upon the work of the station.

Section 5 provides for the necessary expenses of conducting investigations and experiments; also for printing and distributing the results. It will be observed, on referring to said section, that no adequate provision is made for erection of buildings and purchase of suitable land for the work designed; hence it would seem to contemplate that these facilities would be furnished by the respective states. Since these are wanting, it becomes the plain duty of the state to

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furnish them at its earliest convenience, as the lack of these greatly retards the effective use of the station funds at the present time.

In accordance with the provision of section 9, the Governor assented to the said grant in March 1888, and designated the board of regents of the State Agricultural College, as the Board of Control of the station.

At their first meeting, July 2d, 1888, the board appointed E. Grimm, B. S., Director of the station, and in August elected E. R. Lake, M. S., ~~Agriculturalist~~ Horticulturist and Botanist; P. H. Irish, Ph. D., Chemist.

Enforced delay in the organization of the Station Council made it impossible to enter into the experimental work this fall; but no time has been lost in the work of preparation for our future work. The farm had to be brought into suitable condition, quarters had to be provided and apparatus purchased before the active work of experimentation could be commenced. This work has been prosecuted with vigor. A portion of the farm has been tile-drained; soil thermometers planted over the field, as a first step toward a study of the physical properties of the land. The chemical labratory is being equipped, and is nearly ready for active work. While this department is not as well equipped as might be desired, yet it is prepared to do valuable work for the station and will grow as the other departments and needs of the station may demand. In the department of horticulture, work is being rapidly pushed. A forcing house is nearing completion, and the ground is being prepared for spring planting.

The land for the use of the station is the old college farm before mentioned. This land is a fair type of a large portion of the Willamette valley lands, especially in the counties of Marion, Linn, Lane, Benton, and in portions of the other counties. It affords exceptional opportunities for experimental work of great importance to many of our farmers. The soil of the farm is varied in character, and is such as to give ample opportunity to study the physical properties of a very important class of soils. It can not be expected that a farm of thirty-five acres, not chosen with re-

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gard to its particular fitness for the work of the station, will furnish land suitable for all the work of the station. While the land is suited for certain lines of important work, it is certainly unsuited for experimental work in orcharding, grape and peach growing; thus, while it may grow excellent grass, clover and the majority of our ordinary farm crops, it is positively unsuited for many other things. The extent of the station work must, therefore, be limited by the quantity and quality of our land.

This gift, to the state, of thirty-five acres ought to be supplemented by additional purchase for college and station use, in order that the work may be extended, as far as practicable, into the different fields of agriculture.

WORK OF THE STATION.

To state explicitly what will or can be done at this time is impossible. The act of congress providing for the work of the station gives a wide and varied field for its operations. Owing to the conditions above mentioned the work of the station for 1888 must be largely preparatory. The council recognize the fact that to attempt to cover too much ground at present must lead to failure; but an endeavor will be made to select such work as it is thought will prove of interest and practical value to the farmers.

The great variety of soil and climate of Oregon gives great diversity to our agricultural interests. Hence it will be manifestly impossible for the station at present to begin all the work that is needed in the different sections of the whole state. But as our facilities are increased, our lines of work will broaden.

The subjects which will receive the attention of the station at present are the following:

I. Study of the Soils Found on the Farm, and in Different Parts of the State. This will include a study of their natural conditions, the effects of drainage, of different modes of tillage, etc., best methods of maintaining and increasing their fertility, and the use and value of fertilizers. Additional work is planned in experimentation with different varieties

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and methods of cultivation of grains, grasses, roots and forage crops; on the sugar beet, with a view to increasing its sugar contents; with different varieties of apples, prunes and peaches, studying the conditions most favorable for their highest development; on old orchards, including cultivation, best methods of protecting from moss; with forest trees and native grasses and clovers.

In addition to this our chemist will make a thorough study of the chemical composition of our grains, from different parts of the state, of fodders and mineral waters. Thorough investigation of our insect pests and noxious weeds will be made; and of the diseases to which our plants are subject with remedies for the same.

As "climate affects the cultivation of the soil, limits the various crops and determines the nature of the live stock suited to a given place," we hope soon to make the study of climate an important part of the work of the station. It is well known that there are at least three distinct climatic conditions represented by the eastern, western and southern sections of our state, and to make the work of the station more effective we desire, as soon as possible, to establish branch stations in these sections to study the special problems suggested by the conditions found in these several localities. This seems to be more urgent at this time, from the fact that orcharding, which a few years ago was not profitable, on a large scale, is now the leading and growing industry of certain portions of our state, and this may be greatly benefited by judicious work at slight cost. Land suitable for this kind of work is offered, free of charge, to the station in Benton county, and we have no doubt but that in other portions of the state suitable lands can be secured for wider study of these very important branches of agriculture.

It will be seen that certain work of great importance to the state is not included in the above plan such, for example, as the investigation of the relative value of the various breeds of cattle for the purpose of the dairy or for beef; relative cost of producing milk, butter, cheese, etc., and the most economical method of feeding to secure the best results. These are not included in our scheme of work because it is

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impossible, with our present equipment to do work of value upon them.

It therefore appears desirable that provisions be made at once for the erection of suitable buildings and purchase of land to render possible the carrying out of experiments in these lines. The station will have facilities for analyzing soils, dairy products, stock foods and the mineral waters of the state; for investigating all diseases of plants; for identification of insect pests, and study of best methods of protection against their ravages; for testing purity and vitality of seeds. Such work will be done free of charge for the citizens of Oregon, when of public interest. The station can not undertake private work.

The council desire to be in communication with the farmers of the state; correspondence is solicited from those interested in the work of the station, giving suggestions, experience and any information that may aid the station in its work.

Bulletins will be issued quarterly, and will be sent free of charge and postage to every newspaper of the state, and all persons engaged in farming who may desire them. Those desiring the future bulletins of the station will signify the same by postal card.

All communications should be addressed, Director, Oregon Experiment Station, Corvallis, Oregon.

E. GRIMM, Director.

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OREGON

AGRICULTURAL

EXPERIMENT STATION,

BULLETIN No. 2.

HORTICULTURAL.

Preparation and Notes on Future Work.

JANUARY 1889.

CORVALLIS, OREGON:
"BOB'S PRINT," THE TIMES OFFICE.
1889.

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COUNCIL OF STATION.

E. Grimm, B. Sc.,	Director and Agriculturist.
E. R. Lake, M. Sc.,	Horticulturist and Botanist.
P. H. Irish, Ph. D.,	Chemist.

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Horticultural.--Preparation and Notes on Proposed Work.

The work in this division of the Station thus far has been entirely preparatory. Coming to the work late in September, finding scarcely any apparatus and neither land nor material suitable for the season's planting or seeding, it has been impossible to do more than get in readiness for the operations attendant on spring-time. The work of preparation, however, has been so nearly completed in some directions that certain experiments can soon be commenced; but as it will be several weeks before any results can be reached, no more than a record of the preparatory work already done together with an outline of the work proposed for the future can be attempted in this bulletin.

That part of the grounds lying immediately around the College buildings has been thoroughly prepared for experiments with lawn-grass seeds, mixtures of the same and ornamental trees and shrubs. Other portions of the grounds have been under-drained and sub-soiled with a view to their use in testing various kinds of vegetables and small fruits.

In the meantime seeds, trees, shrubs and plants have been procured from widely different sources for the purpose of determing, if possible, the varieties best suited to this soil and climate.

FORCING-HOUSE.

For the purpose of testing the vitality of commercial seeds and for propagating plants for experimental purposes a forcing-house has been built, and equipped as far as our means would permit. The ground plan of this building is forty by eighteen feet. A part of this space, sixteen by eighteen feet, is covered by a frame structure ten feet high, with a six-foot basement. This is to be used as a store-room, tool-room, potting-room and general workshop. The remaining space,

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twenty-four by eighteen feet, is an ordinary span-roof forcing-house, ten feet high at the center and three feet at the sides. On either side of this room and across the ends, except door-spaces, are tables thirty inches wide and of the same height, while in the center is a raised stand of considerable area. The heating of this room is done with hot water which circulates in three flow and three return two-inch pipes that are laid under and eight inches below the tables. The pipes are supplied by a coil—made from one-inch gas pipe, having three turns twelve inches in the clear, and a height of fifteen inches—which is set in brickwork in the basement of the other part.

The whole cost of the building was, in round figures, $600, and the average daily cost of fuel for the last month (not allowing the temperature to go below 50° F. during the night or 68° F. during the day) has been sixty cents.

SEED-TESTING.

The testing of the purity and vitality of commercial seeds has been begun. The smaller seeds will be tested in Krelage test plates. These plates are made of the best Holland pot-clay, are five inches in diameter, one-half inch thick and unglazed, with five or more pockets in one face; in other words, they are simply a disk of porous clay of the above dimensions with five or more shallow cavities in one face for the reception of the seeds. While these plates are not in general use in the United States, they are highly recommended by European authorities. The larger seeds will be tested in sand.

As the requisites for germinating seeds are heat, air and moisture, it only becomes necessary to supply these in normal amounts and under normal conditions to get the desired results—per cent. of vitality.

From what has been said before, it will be readily understood how we may do this with reference to the first requisite. Of the second we need say nothing, while of the third, it may be said that by way of experiment several devices will be resorted to, but in the main only one method will be followed, viz: setting the plates in a tray or shallow pan contain-

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ing water at all times. We purpose also testing the seeds in ordinary soil and pure sand in order to compare the results —of what some are pleased to call the more natural way— with those of the plate method. The principal reason for the use of the plates is convenience.

Judging by the results obtained from the work already done in seed-testing, it would seem that no small share of attention ought to be given to this subject. In the tests made at the Michigan Agricultural College in 1883 it was found that on the average, only 62 per cent. of the seeds tested germinated. Tests made at the Experiment Station of South Carolina gave 56 as the average percentage of vitality, while in the tests at the Vermont Experiment Station, an average of 70 per cent. germinated. The impurities were not given in detail, but the whole was summed up in the term trash, which ranged from 0–26 per cent. with an average of over 10 per cent. These illustrations, fair samples of the work done, show to some extent the importance of work in this direction. The good that may be done by showing how much and with what our commercial seeds are adulterated affords reason enough for some work, especially, when we consider what nuisances some of the weeds are that have been introduced by means of the commercial seed package.

INSECT PESTS.

Perhaps the subject that calls most urgently for the attention of the horticulturist is that of the insects injurious to fruit growing. At present the most troublesome one, though by no means the only one, is the codling moth (*Carpocapsa pomonella*) There seems to be no longer any need for grave fears of this pest, for experiments by the score confirm the statement made several years ago by leading scientists that Paris green or London purple would effectively check the moth's destructive work

It has taken several years for this simple remedy to come into general use among the fruit growers, and even now there is a strong feeling that, though it is widely known, there will be need of legislation before the more thriftless

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cultivators will apply it. Without united action by the orchardists of a section its effectiveness is much lessened, for the untreated trees furnish a nursery from which the moths issue in hundreds, thus rendering, in some cases at least, previous sprayings in adjacent orchards useless. For experiment with insecticides we think it safe to say there is no better subject in our State than the orchard at the College. This orchard now consists of sixty-four apple trees, seven pear trees and sixteen plum trees.

Of apples there are Baldwin, Rambo, Spitzenberg, Fall Pippin (?), Grindstone Pippin (?), Early Harvest (?).

Of pears, LeConte, Winter Nelis, Seckel and others, the names of which are unknown.

Of plums, five varieties, the names of which are in doubt.

Last fall there was not over a bushel of apples free from the moth's ravages; although the crop was one of more than average yield.

The pears yielded well, but were scabby, gritty and malformed, while the plums were of good yield and fair quality.

Our inventory of stock on hand, after the crop had been cared for, revealed a very gratifying prospect for the future work with insecticides. From a space of six inches square on the trunk of one small tree there were taken twenty-two larvæ of the codling moth, while from the trunks of several other trees three and four times as many were taken. Besides *the moth* there are a half dozen or more other insects, more or less destructive to plant life, that are wintering in this same orchard. Take it, all in all, this orchard, which is an insect nursery with no small stock, affords an excellent opportunity for testing the value of various insecticides.

For the benefit of those who have reported the finding of innumerable small, yellowish insects in orchards and gardens, and have sent specimens for information, we would say: "They are species, more than two were found, of the lowest order (*Thysanura*) of insects. They are commonly called spring-tails, bristle-tails, etc., and live, usually, under bark, moss, decaying wood, leaves, etc., and are not known to be injurious."—*C. P. Gillette.*

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MOSS.

This is a subject that lays claim to some attention. That it is no local issue the orchards of the State attest. While its presence may be no serious injury, as some affirm, its removal from the orchards in general would decidedly improve their appearance, which in itself is no small item.

SMALL FRUITS.

As there are no small fruits on the college ground, the following preliminary list will be set out in the spring. More are in contemplation, but lack of space at present forbids larger plantings.

CURRANTS—White Dutch, Red Dutch, LaFertile, LaVersailles, Yellow Transparent, Victoria, Cherry, White Grape.

GOOSEBERRIES—Downing, Oregon Champion, Smith's Improved.

BLACKBERRIES—Kittatinny, Evergreen, Early Harvest.

RASPBERRIES—(red) Hansel, Turner, Marlborough, Cuthbert; (black) Gregg, Mammoth Cluster.

STRAWBERRIES—Jessie, Summit, Bubach, Lida, Covell, Ohio, Ontario, Henderson, Belmont, May King.

The orchard will be supplemented with:

PEARS—Bartlett, Beurre d' Anjou, Louise Bonne de Jersey, Vicar of Winkfield, Duchess d' Angouleme.

PLUMS—Bradshaw, Columbia, Peach.

PRUNES—Italian, d' Agen.

CHERRIES—Black Republican, Black Tartarian, Elton, Royal Ann, Rockport.

QUINCES—Orange, Champion, Rea's Mammoth.

GRAPES—Goethe, Max or Mass, Massasoit, Telegraph, Salem, Agawam, Prentiss, Early Victor, Amber Queen, Eumelan, Ionia, Whitehall, Wilder, Moore's Early, Hartford, Eldorado, Cornucopia, Brighton, Perkins, Lady, Creveling, Centennial, Brandt, Niagara.

ORNAMENTAL AND NUT TREES.

The plantings of these will be limited, but especial attention will be given to the cultivation of nut-bearing trees, such as English and black walnuts, butternuts, hickory nuts, chestnuts and filberts.

In connection with the growing of ornamental trees there will be some attention given to timber trees; as pines, firs, spruces, locusts, ashes, catalpas, lindens and sugar maple.

OUR NEEDS.

Recognizing that a close relation between the farmers and the Station ought to exist, their attention is again called to the fact that "the Station has facilities for analyzing soils, dairy products, stock foods and the mineral waters of

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the State; for investigating all diseases of plants; for identification of insect pests, and study of best methods of protection against their ravages, and for testing purity and vitality of seeds. Such work will be done free of charge for the citizens of Oregon, when of public interest. The Station can not undertake private work."—*Bulletin No.* 1.

Especially is it desired that you note the part referring to plants and insects. If it is observed that a smut, mildew, rust or an insect is in any way injuring a crop, please send specimens of the diseased plant or injurious insect with any information thought to be of value. Of noxious weeds, send, if convenient, the whole plant—root, stem, leaves, flowers and fruit—with information regarding manner of growth, etc. A prompt reply is promised of any information that we can give regarding the pest.

The co-operation of all fruit growers is earnestly desired that the Station may become a source of profit to those interested in this branch of agriculture.

E. R. LAKE,

JANUARY, 1889. *Botanist and Horticulturist.*

In presenting this partial report of the work done in seed-testing we are constrained to say that although the disadvantages under which the work was carried on materially reduced the quantity of the result, they in no wise affected the accuracy of the results given in the table. The low percentage of germination in several of the first tests gave rise to doubt. This was, however, dispelled when upon repeated trials the same percentage was obtained.

The fact that more seeds were tested in sand than in plates is due to a misunderstanding in ordering apparatus. In so far as comparisons have been made the results with the plates have been slightly lower than with sand.

The subject of impurities will follow in a later report.

In the column designated "from" the abbreviations are explained as follows: Sal.=Salzer, Lacrosse, Wis.; Dick.=Dickinson, Salem, Oregon; Cart.=Carter, London, England; Star.=Starrett, Walla Walla, Wash.

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VARIETIES.	Number of seeds tested	Temperature	Manner of Testing	Last seed germinated in—days.	Per cent. of Seeds germinated	From
BEANS			Moist			
King of the Garden (Lima)..	28	50-70	Sand	7	100	Sal.
White Case Knife (pole)....	50	"	"	7	96	"
Golden Butter Wax (pole)..	50	"	"	4	98	"
Black Wax.....	50	"	"	7	86	"
Improved Lima.....	22	"	"	7	100	"
Improved early 6 W'ks Gem	50	"	"	7	98	"
New Golden Refuge.....	50	"	"	7	72	"
Dwarf Weiser.....	50	"	"	4	100	Dick.
Early Mohawk.....	50	"	"	7	100	"
Horticultural.....	50	"	"	4	100	"
German Wax.....	50	"	"	7	96	"
White Advancer, (French)..	50	"	"		100	Cart.
BEETS						
Carter's Perfection.....	100	"	"			
Eclipse.....	"	"	"	7	70	Star.
White French Sugar.....	"	"	"	8	63	"
Dark Red Egyptian Turnip	"	"	"	7	26	"
Long Dark Blood.....	"	"	"	7	53	"
Large Red Mangel Wurtzel	"	"	"	8	39	"
EarlyBassano.....	"	"	"	8	71	"
Early Blood Turnip-rooted	"	"	"	8	61	"
Early Long Blood.....	50	"	"	7	44	Dick.
Yellow Globe.....	"	"	"	7	52	"
White Sugar.....	"	"	"	7	26	"
Long Red Mangel.....	"	"	"	7	86	"
Norbitan Giant Mangel.....	"	"	"	7	64	"
BROCCOLI						
Snow's Winter Sandringham	100	"	"	5	100	Cart.
White French.....	"	"	"	8	86	Dick.
BRUSSELS SPROUTS	"	"	"	6	64	"
CABBAGE						
Early Drumhead.....	100	"	"	3	99	Star.
Early Winningstadt.....	"	"	"	6	100	"
Red Dutch.....	"	"	"	6	93	"
Early Oxheart.....	"	"	"	7	85	"
Late Flat Dutch.....	"	"	"	7	100	"
Early Dwarf York.....	"	"	"	6	100	"
Fottler's Impr'vd Brunswick	"	"	"	7	45	"
Mammoth Marblehead.....	"	"	"	7	99	"
Large Early York.....	"	"	"	7	87	"
Early Dwarf Flat Dutch....	"	"	"	6	40	"
Large Late Drumhead.....	"	"	"	7	99	"
Early Jersey Wakefield....	"	"	"	3	98	"

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VARIETIES.	Number of seeds tested.	Temperature	Manner of Testing.	Last seed germinated in—days.	Per cent of Seeds germinated.	From
CABBAGE—Continued			porous			
Early Winningstadt	100	50-70	plates	14	73	Dick.
Early Jersey Wakefield	"	"	"	14	68	"
Filder Kraut	"	"	"	13	85	"
Early Dutch	"	"	"	9	88	"
Mammoth Marblehead	"	"	"	13	58	"
Early Brunswick	"	"	"	13	83	"
Drumhead Savoy	"	"	"	9	98	"
Early York	"	"	"	9	83	"
Salzer's Earliest	"	"	"	8	96	Sal.
All Seasons	"	"	"	9	80	"
Northern Jersey Wakefield	"	"	"	6	94	"
Red Dutch	"	"	"	6	90	"
Giant Flat Dutch	"	"	"	8	94	"
Filder Kraut	"	"	"	13	83	"
Sure-head	50	"	"	13	75	U.S.dept Agr'l.
CARROTS						
Early	100	"	"	14	80	Dick.
White Belgian	"	"	"	14	50	"
Danvers Yellow	"	"	"	11	75	Sal.
Guerande	"	"	"	11	73	"
Scarlet Nantes	"	"	"	11	95	"
Long Cassaby	"	"	"	12	52	U. S.
Large Yellow Belgian	"	"	"	11	46	Star.
Danvers	"	"	"	12	93	"
Early Scarlet Horn	"	"	"	8	83	"
Large White Belgian	"	"	"	12	34	"
Yellow Danvers	"	"	"	12	63	Dick.
Long Orange	"	"	"	14	95	"
Half Long Orange	"	"	"	11	88	"
CAULIFLOWER						
Lionormand Short Stem	100	"	"	8	83	"
Early Erfurt	"	"	"	9	71	"
Carter's Mont Blanc	"	"	Sand	8	97	Cart.
Early Paris	"	"	"	5	94	Star.
Early Snowball	"	"	"		96	Sal.
Early Paris	"	"	Plates	5	97	"
Early Lacrosse Favorite	"	"	"	13	39	"
CELERY						
Salzer's Giant White	100	"	"	13	56	"
White Solid	"	"	"	10	100	Dick.
CORN						
Perry's Hybrid Sweet	50	"	Sand		92	Sal.

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VARIETIES	Number of seeds tested.	Temperature.	Manner of testing.	Last seed germinated in—days.	Per cent. of seeds germinated.	From.
CORN—Continued			Sand.			
Salzer's Northern Pedigree	25	50-70	"		80	Sal.
Early Lacrosse	25	"	"		64	"
Early Minnesota	25	"	"		84	"
Stowell's Evergreen	25	"	"		100	Dick.
Sweet Minnesota	50	"	"		96	"
Cory	50	"	"		90	"
CUCUMBER						
Extra Long Green	25	"	Plates.		84	"
Early Frame	25	"	"		24	"
Early Green Cluster	25	"	"		100	"
White Spine	25	"	"		92	"
Early Frame	25	"	Sand.	6	80	Star.
Early Russian	25	"	"	"	48	"
Improved Long Green	25	"	"	"	160	"
Boston Pickling	25	"	"	7	72	"
Early White Spine	25	"	"	6	12	"
EGG PLANT						
Long Purple	100	"	"	9	17	"
ENDIVE						
Carter's Model	"	"	"	3	78	Cart.
Moss Curled	"	"	"	5	84	Star.
KOHL RABI						
Salzer's Purple Vienna	"	"	"	8	78	Sal.
Early White	"	"	"	"	99	"
LAND CRESS	50	"	Plates.	"	96	Dick.
LAVENDER	100	"	"	12	3	Star.
LEEK						
Carter's Holborn Model	50	"	"	8	38	Cart.
London Broad Flag	"	"	"	8	72	Star.
LETTUCE						
Tennis Ball	100	"	"	12	93	Sal.
Improved Hanson	"	"	"	"	81	"
Green Winter	"	"	"	"	85	"
Satisfaction	"	"	"	11	64	"
The Deacon	"	"	"	"	98	"
White Cabbage	"	"	Sand.	3	100	Star.
Simpson's Early Curled	"	"	"	2	"	"
Golden Hearted	"	"	"	"	"	"
Boston Curled	"	"	"	3	"	"
Curled India	"	"	"	"	"	"
White Batavian	"	"	Plates.	12	96	Dick.
Ice Cos	"	"	"	"	92	"
Sugar	"	"	"	13	52	"

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VARIETIES.	Number of seeds tested.	Temperature.	Manner of testing.	Last seed germinated in—days.	Per cent. of seeds germinated.	From.
MELONS—Musk.						
Hackensack	25	50-70	Sand.	9	56	Star.
Banana	"	"	"	"	44	"
Jenny Lind	"	"	"	"	64	"
Early Cassaba	"	"	"	"	64	"
Surprise	"	"	"	"	76	"
Pine Apple	"	"	"	7	80	"
Montreal Market	"	"	"	"	100	"
Sutton's Green Citron	"	"	"	"	"	"
Large Nutmeg	"	"	"	"	40	Sal.
Cassaba or Large Persian	"	"	"	6	56	"
MELONS—Water.						
Mountain Sweet	"	"	"	9	48	Star.
Peerless or Ice Cream	"	"	"	"	36	"
New Orange	"	"	"	"	4	"
Cuban Queen	"	"	"	7	24	"
MUSTARD						
White	100	"	"	5	100	Dick.
Brown	"	"	"	6	73	"
White	"	"	"	3	100	Star.
ONIONS						
Oregon Yellow Danvers	"	"	"	8	98	Dick.
Early Flat Rock	"	"	"	6	74	"
Early Red Wethersfield	"	"	"	"	92	"
White Globe	"	"	"	8	50	Sal.
New Queen	"	"	"	"	30	"
Extra Early Red Globe	"	"	"	"	87	"
Danvers Yellow Globe	"	"	"	"	84	"
Mammoth Pompeii	"	"	"	"	63	"
Giant Silver King	"	"	"	"	65	"
Large Red Wethersfield	"	"	"	"	32	"
Early Red Wethersfield	"	"	"	"	87	Star.
Globe Danvers	"	"	"	"	88	"
PEAS						
Carter's Telephone	50	"	"	6	98	Cart.
Stratagem	"	"	"	"	98	"
Cleveland's New Alaska	"	"	"	5	98	Sal.
Tom Thumb Dwarf	"	"	"	4	92	"
Champion of England	"	"	"	5	78	"
Salzer's Earliest & Best	"	"	"	"	100	"
McLean's Little Gem	"	"	"	"	98	"
Everbearing New Alaska	"	"	"	"	98	"
Veitch's Perfection	"	"	"	"	92	Dick.
American Wonder	"	"	"	4	94	"
Little Gem	"	"	"	"	84	"

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VARIETIES	Number of seeds tested.	Temperature	Manner of Testing.	Last seed germinated in—days.	Per cent of Seeds germinated.	From
PEPPERS						
Golden Down	100	50-70	Sand	9	18	Star.
Sweet Mountain	"	"	"	9	25	"
PUMPKIN						
Connecticut Yellow	13	"	"	7	86	Dick.
RADISH						
French Breakfast	100	"	"	"	99	Star.
Early Scarlet Turnip	"	"	"	"	96	"
Chinese Rose Winter	"	"	"	"	94	"
Golden Globe	"	"	"	"	98	"
White Turnip	"	"	"	"	99	"
Chartier	"	"	"	"	"	"
Olive Rose	"	"	"	"	60	"
Long Red	"	"	"	"	98	Sal.
Earfurt Dark Red	"	"	"		95	"
Chartier	"	"	"		94	"
Giant White Stuttgart	"	"	"		100	"
Golden Globe	"	"	"	7	94	"
Early Scarlet Turnip	"	"	"	"	100	"
Scarlet Olive	"	"	"		90	"
Scarlet Turnip	"	"	"	7	96	Dick.
French Breakfast	"	"	"	"	97	"
Peerless	"	"	"	"	96	"
Long Scarlet	"	"	"	"	94	"
Chartier	"	"	"	"	100	"
RHUBARB	25	"	"	8	32	"
RUTA BAGA						
Sutton's Champion	100	"	"	7	93	"
Sweet German	"	"	"	6	100	"
Early Flat Dutch	"	"	"	8	"	
Early Red Top Strap-leaf	"	"	"	"	"	"
Skirvings Purple Top	"	"	"	"	"	Star.
SALSIFY						
Salzer's Early	25	"	"	7	36	Sal.
SPINACH						"
Long Standing	50	"	"	8	32	"
Salzer's Savoy	"	"	"	"	28	"
Round or Summer	"	"	"	"	24	"
Winter Prickly	"	"	"	"	26	"
Am. Savoy-leaved	"	"	"	"	84	Star.
SQUASH						
Boston Marrow	25	"	"	9	32	"
Summer Golden Crookneck	"	"	"	7	80	"

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VARIETIES.	Number of seeds tested.	Temperature.	Manner of testing.	Last seed germinated In—days.	Per cent. of seeds germinated.	From.
SQUASH—continued			Sand.			
Marblehead	25	50-70	"	9	8	Star.
White Pine Apple	25	"	"	6	52	"
Improved Hubbard	25	"	"	9	32	"
White Bush Scallop	25	"	"	6	84	"
Essex Hybrid	25	"	"	9	88	"
Early Summer Crookneck	25	"	"	9	79	Dick.
Marblehead	25	"	"	6	60	"
Early White Scalloped	25	"	"	7	92	"
Laws Premium	25	"	"	9	68	"
Hubbard	25	"	"	9	8	"
White Bush	25	"	"	7	100	Sal.
Marblehead	25	"	"	5	4	"
SUNFLOWER	13	"	"	12	93	Star.
SWEET MAJORAM	100	"	"		27	
THYME	"	"	"	"	13	
TOBACCO						
Connecticut Seed-leaf	"	"	Plates.	14	67	Star.
Wisconsin Hybrid	"	"	"	12	72	Sal.
Imported Havanna	"	"	"	14	64	"
Kentucky Home	"	"	"	14	75	"
TOMATO						
Turners Hybrid	"	"	Sand.	14	64	
Early Mayflower	"	"	"	14	92	
General Grant	"	"	"	7	40	
Mikado	"	"	"	14	85	
Cardinal	"	"	"	14	52	
Red Trophy	"	"	"	7	97	
Paragon	"	"	"	7	92	
Morning Star	"	"	"	11	87	
Conqueror	"	"	"	14	94	
Strawberry or Ground	"	"	"	14	41	
One Hundred Day	"	"	"	8	72	
Yellow	"	"	"	8	93	
Smooth Red	"	"	"	14	97	Dick.
Hathaway's Excelsior	"	"	"	11	42	Star.
Livingston's Perfection	"	"	"	11	17	"
Paragon	"	"	"	11	63	"
Early Acme	"	"	"	8	97	"
General Grant	"	"	"	11	81	"
Golden Gage	"	"	"	11	30	"
Red Trophy	"	"	"	11	78	"
FORAGE						
Red Clover	"	"	Plates.	7	93	Dick.

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VARIETIES.	Number of seeds tested	Temperature	Manner of Testing	Per cent. of seeds germinated.	Last seed germinated in—days.	From
FORAGE—Continued						
Lincoln Grass	100	50-70	Plates	95	11	Dick.
Orchard Grass	"	"	"	43	"	"
Hungarian Grass	"	"	"	32	"	"
German Millet	"	"	"	70	6	"
White Clover	"	"	"	82	11	"
Common Millet	"	"	"	98	6	"
Alsike Clover	"	"	"	65	10	"
Perennial Rye Grass	"	"	"	76	11	"
Italian. " "	"	"	"	42	10	"
Kentucky Blue Grass	"	"	"	10	12	"
Sheep's Fescue	"	"	"	19	11	"
Meadow "	"	"	"	58	12	"
Alfalfa	"	"	"	80	7	"

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OREGON

AGRICULTURAL EXPERIMENT

STATION.

BULLETIN NO. 3.

ENTOMOLOGY.

I.—PRACTICAL WORK WITH INSECTICIDES.
II.—CORN WORM.
III.—INSECTICIDES.
IV.—SPRAYING MACHINES.
V.—DIRECTIONS FOR SENDING INSECTS.

CHEMISTRY.

VI.—SOME INVESTIGATIONS ON PLANTS POISONOUS TO STOCK.

OCTOBER, 1889.

The Bulletins of this Station are sent free to all residents of the State who request them.

THE LEWIS & DRYDEN PRINTING CO., PORTLAND, OR.

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PRACTICAL WORK WITH INSECTICIDES.

E. R. LAKE.

The practical work with insecticides at the Station this year covered the treatment of fifteen apple trees and three pear trees with London purple for the codling moth, twenty apple trees with kerosene emulsion for the woolly aphis, and several greenhouse plants with the same emulsion and tobacco water for the green aphis. The trees selected for treatment were located in various parts of the college orchard and consequently surrounded by untreated trees which may have influenced the results of our work to a greater or less extent. Lack of time and the need of competent assistance prevented more extensive work, and, in fact, even seriously curtailed several phases of the work attempted. Therefore, while we feel that this report cannot contain any elaborate or even finished experiments it will serve to indicate the lines of work pursued with insecticides and furnish some data for next year's operations.

CODLING MOTH.

On April 30th, some days after the apple blossoms had generally fallen, yet while the apples were "standing," the above mentioned eighteen trees were sprayed with a London purple mixture—4½ oz. to 48 gals. water. As the trees on the whole are rather above the average size, two of them being especially large, about seventy-five gallons of the mixture was applied at this spraying, making a little over four gallons to each tree.

On May 23d these same trees were sprayed a second time. The mixture was reduced in strength—3 oz. to 48 gals.—but in quantity remained the same.

On June 13th all the trees except Nos. 10, 11, 12, 13 and 14 received the third spraying. The mixture was again reduced in strength—2½ ozs. to 48 gals.—and also in quantity, about three gallons per tree being applied.

The fourth spraying, Aug. 12th, was a duplicate of the third.

We deemed this sufficient, and as apparently evident proof, found upon examination that a very small per cent. of the fruit on the treated trees was affected, while over 50 per cent. of the fruit on the untreated trees was injured. Soon after this date the late summer and early autumn apples began to fall very rapidly. For some time these were kept picked up but later they were left on the ground. In the meantime bands of coarse cloth were tied around several trees and a daily record kept of the larvæ caught under them.

A few days after the first spraying the foliage of one tree—a vigorous Baldwin—was observed to be seriously burned. Portions of the foliage of two other trees were also more or less burned. In the latter case it was at-

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tributed to the unequal strength of the mixture as occasionally the mixing stream would fail to do its work well. In the former case no such reason could be assigned as the whole foliage was quite uniformly burned. The cause here was evidently too strong a mixture. At the second spraying similar results were observed on two other trees. These like the one before were rather more vigorous than the others. At the third and fourth sprayings no injury was noticed. In all cases the pear foliage was less affected than the apple foliage.

In order to determine whether or not the age of the foliage entered into the problem of burning, an extra strong mixture was applied to one tree at this time, but no injurious results were noted. This, along with the observations made on the other trees at the various times of spraying, lead us to conclude that young and vigorous foliage is more susceptible to injury from the arsenites than older or less vigorous foliage. The fact that the pear foliage was less affected than the apple may have been due to the same cause as it was more advanced than the latter at the time of spraying.

Observations made for two weeks after the first spraying failed to give any indications of the moth's work in the fruit of either sprayed or unsprayed trees, though many of the cocoons on the trunks of the trees had been abandoned. Cocoons that had a few days previously—to our knowledge—contained larvæ (?) were found deserted as early as April 20th.

About May 25th, several larvæ were found in the fruit of the untreated trees. Five days after a few larvæ were taken from the fruit of the sprayed trees. By the first of June at least 20 per cent. of the fruit on the unsprayed portion of the orchard was affected, while scarcely more than 5 per cent. of that on the treated part showed any injury done. From this time till Oct. 1st the percentage of affected fruit on the unsprayed trees steadily increased while it remained practically the same on the sprayed ones till the latter part of August, but from that time to date of picking—Oct. 1st—it increased so rapidly that the final results on some trees of both sprayed and unsprayed were about the same. We had considered it unsafe to spray later than Aug. 12th, but the results would strongly indicate that had we omitted the first spraying and given another in the latter part of August effective work would have been done.

The following figures give the percentages of sound and wormy fruit found on picking. Several trees are omitted because there were not suitable check trees.

NO.	SOUND.	WORMY.	
1	10 per cent.	90 per cent.	Sprayed.
Check 2	6½ per cent.	93½ per cent.	Unsprayed.
3	50 per cent.	50 per cent.	Sprayed.
Check 4	51 per cent.	49 per cent.	Unsprayed.
5	70 per cent.	30 per cent.	Sprayed.
Check 6	57 per cent.	43 per cent.	Unsprayed.

No accurate record could be kept of Nos. 7, 8, 9 as they are pear trees and growing near College Hall. Two points of interest, however, were ob-

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served, namely, that while the fruit on a large tree of Summer Doyenne was not injured by the moth, the fruit of a Pound Pear and Winter Nellis were much affected.

The figures given below are simply for the purpose of emphazising the fact that removing all fallen apples from the orchard is an important factor in the warfare against this pest. From August 2d to August 27th all fallen apples were removed from a part of the orchard and the total catch of larvæ under bands was seven. During the same time a total catch of 257 larvæ was made in that part of the orchard where the fallen apples were allowed to remain on the ground.

The fruit on Nos. 10, 11, 12, 13, 14—trees that were sprayed only twice, April 30th and May 23d—was entirely worthless. Many larvæ were found just entering the fruit at the time of picking. In some cases at least they were not more than six to ten days old. Had all fallen apples been destroyed it is quite fair to suppose such late larvæ would not have been found.

By way of a summary of the season's work, we draw the following conclusions:

1. Early spraying—just after the blossoms fall—is useless.
2. A mixture of 6 oz. of London purple to a hundred gallons of water is better than a stronger one.
3. The mixture should be kept thoroughly stirred while being used.
4. Young and vigorous foliage is more susceptible to injury by burning from the application of arsenites than is older or less vigorous foliage.
5. Spraying as late as September 1st or even later on winter apples is desirable as far as fighting the moth is concerned. (There may be some danger in such late spraying however, and this is one phase of the subject for next year's work.)
6. All fallen apples that are affected should be destroyed daily.
7. The cost per tree for each spraying will average in small orchards about three cents. In larger orchards it would be less.

WOOLLY APHIS.

This pest was found on nearly every apple tree in the orchard. Twenty of the worst affected ones were treated with a hot kerosene emulsion. The application being made with an ordinary spray pump. The following strength was used for the first application.

Kerosene, one pint,
Whale oil, one quarter pound,
Water, two quarts.

The water and soap were heated together and then the oil was added and all thoroughly churned with a force pump. This was then diluted with five gallons of hot water and applied.

The results were not entirely satisfactory, so an application of lye-water was next given. This fully answered the purpose.

One pound of concentrated lye to three gallons of water.

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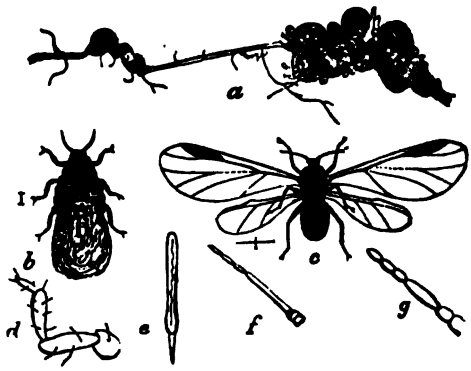


Fig. 18.

WOOLLY APHIS (*Schizoneura lanigera*); (after Riley).

a, an infested root; b, the larva—color, brown; c, winged adult—colors, black and yellow; d, its leg; e, its beak; f, its antennæ; g, antennæ of the larva; b, all, highly magnified.

This insect is of a dark russet brown color, with the abdomen covered with a white down, of cottony appearance. It attacks the roots, trunks and branches of apple, pear and cherry trees. It does not affect the leaves or fruit.—*Cooke.*

GREEN APHIS.

The only cases treated were some green-house plants. A tobacco decoction made by boiling refuse tobacco stems in water proved to be the most beneficial remedy. A handful of stems to one quart of water or one pound of stems to two gallons of water will make a strong enough decoction.

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CORN WORM.

F. L. WASHBURN..

[*Living in the ears of corn and feeding upon the kernels; a green, brown or grey, sixteen-legged worm, marked with darker stripes.*]

The head is brown, the body sparsely covered with polished black elevated dots, and a very few fine and short hairs. When full grown it measures from one inch to one and one-half inches in length. It sometimes assumes the pupa form in its burrow in the corn, but usually descends to the ground, which it enters and forms a smooth cell in which to undergo its transformations. The pupa is brown, the moth pale yellow, tinged with olive green. This disgusting pest has been very abundant this year about Corvallis, and I have heard of its depredations from other quarters. It is not a newcomer amongst us, however. A number of farmers have observed it this year for the first time, but others and careful observers, too, report that they have seen it, in some abundance, for four years, and still others say it has been here for eight or ten years or more. This is only another instance of the fact that casual observers do not notice an insect, though it may have been with them for some time, until the increased extent of its depredations forces it upon their attention. Another cause for this difference of report undoubtedly lies in the fact that its depredations have been local, the corn of some farms having been entirely exempt until three years ago, or less. This is its first year on the Agricultural Farm.

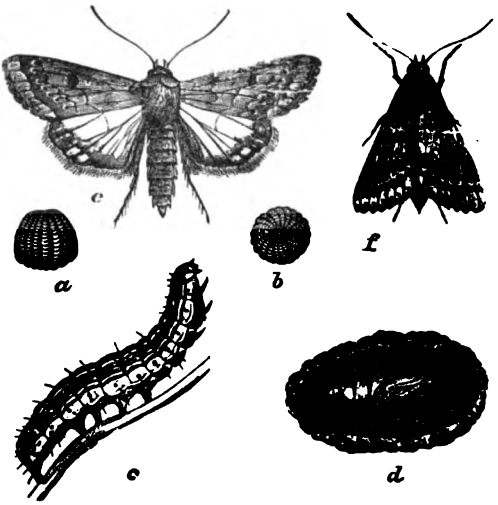


FIG. 19.
CORN WORM OR BALL WORM.
(*Heliothis Armigera.*)
c, the worm; *d*, the pupa in its cell; *e*, the moth with wings expanded; *f*, the same with wings closed; *a*, an egg, side view, highly magnified; *b*, the same, top view(after Riley).

Its method of work is as follows: Eating through the silk at the end of

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the ear it feeds upon the soft kernels within, making a burrow and practically spoiling nearly a half of each ear. Mold forms in the burrow.

When about to pupate (i. e. to form a cocoon in which it passes its quiescent stage just before becoming a moth) it eats through the husk, issuing through a small hole, and descending to the ground, enters it a very short distance and there forms its cocoon. Mr. Crees reports it as doing some damage to tomato fruit on his farm near Corvallis, and reports from the East and South sustain this charge. It is said that one worm will render unfit for eating the entire fruit on one tomato vine. It is reported, also, as injuring peas, the moth finding a feast in the sweet honey of the blossom.

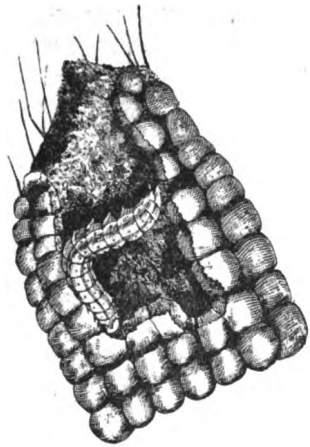


FIG. 20.
Corn Worm at work. (Original.)

The worms vary much in color, being a very pale brown, a purplish brown, grey and green; but, whatever the color, a narrow indistinct darker band down the middle of the back, two broader darker bands on each side, bordered below with light, together with the elevated black dots over the body, are sufficient to identify them. There are three broods in localities properly conditioned as to climate, etc. There are undoubtedly three broods here during the season, for on some late Stowell's Evergreen corn, Oct. 1st of this year I found some very large worms about ready to pupate, some medium-sized and some exceedingly small. Consequently, the worms being most numerous after the second and third brood appear, the matter needs especial attention during August and September.

REMEDIES.

In this case as in that of all other insect pests the first thing to do is, to use a slang expression, "to take the bull by the horns" and destroy the caterpillar by every possible means. Feed affected ears to stock at once; do not let them remain in stack on the field with the worm in them. If you have not a sufficient number of hogs or other stock to use up the corn, take some of it into the hen yard; HUSK IT THERE. If you are raising a little corn, only, for table use, hand-picking of worm and then destroying it might be feasible. Encourage the presence of blue birds about your corn fields; they help, and crows, black-birds and jays eat the worm, asking but little pay in the shape of corn. An excellent thing is to allow a large brood of turkeys and chickens to range through the corn field; the former have quick eyes for any worm wandering from its burrow, and the latter pick up the moths.

Your corn field cleared, plow affected areas in the fall, that the cold may penetrate the top earth and destroy those worms that have left the corn and pupated in the ground. Further, as an extra precaution, spray the ears of

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corn thoroughly the year following the above treatment with a mixture of whale oil soap and sulphur, just as the silk is forming.

The proportions are one-third as much sulphur as soap. Take one pound of this mixture to every gallon of water used. Apply at a temperature of 130° Fahrenheit. This is said to effectually prevent the moth from depositing its eggs on the silk.

TO MIX 10 POUNDS OF WHALE OIL SOAP AND 3 POUNDS OF SULPHUR.

[Boil, say four gallons of water, then add the sulphur and boil ten or fifteen minutes. Dissolve 4 lbs. of American concentrated lye in a gallon of water, and add to the sulphur and water. Boil five minutes; then add the soap and boil for five minutes. Then place in barrel, add thirteen gallons of water and it is ready for use. It should be made at least one week before using to allow the sulphur to become quite fetid, and should be applied at a temperature of 130° Fahrenheit.]

The above means, i. e. killing the caterpillar, plowing and spraying, are being adopted at this station, and with the cooperation of the neighboring farmers we feel certain we will greatly lessen or entirely stamp out this pest. If, for any reason, you are prevented from spraying, by no means neglect the other measures mentioned. They are very important.



FIG. 22.
Green corn infested with corn worm.
(From a photograph.)

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INSECTICIDES.

F. L. WASHBURN.

We all know that fully one half of the caterpillars, or "worms" infesting our fruit trees will produce female moths, and each female moth, if undisturbed, will lay from fifty to two hundred eggs; they, in their turn, to produce as many or nearly as many caterpillars. Hence we recognize the importance of killing, as far as possible, all of the "worms" before they have a chance to turn into moths.

We must also acknowledge the very great aid, in exterminating these pests, offered by the proper use of insecticides, Paris Green, London Purple, etc. In fact, they, if wisely used, play more than half the part in exterminating these pests. Primarily, and this is their greatest virtue, they kill the caterpillar, or "worm," before it has had a chance to harm the fruit, and secondarily, they, in many cases, effectually keep the moth from depositing its dangerous eggs. The two insecticides mentioned above have been most successfully tried as remedies against the codling moth at various experiment stations. In one case, where the experiment was most carefully conducted, the use of Paris Green saved *seven tenths* of a crop of apples which would otherwise have been sacrificed to this moth, and its cost, in this case, about ten cents per tree. But experiments at this station show that it can be done for much less money.

Right here it must be noted that the above experiment was conducted under most severe and careful conditions, and in making his statements the experimenter was confident that his work had been thoroughly done and his observations scientifically accurate. It is only on such sure grounds that one has a right to judge of the success or non-success of spraying.

This tempts us to enumerate some of the conditions that should be observed in the use of insecticides to insure success. That success will follow their proper application is practically beyond a question.

CONDITIONS TO BE OBSERVED.

1. Have the dealer warrant his insecticides to be of good quality. Deal with only reliable firms.

2. Follow *implicitly* the directions for mixing, etc. It is well to make a thin paste first, by stirring a little water with the poison, and then adding the full complement of water.

3. *The liquid should be kept constantly stirred while spraying.* If the liquid is evenly colored at this time it is a proof that it is being properly stirred. That is, it proves that poison is in every drop of water. There are

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special contrivances to effect this. (See following article on Spraying Machines.) The faintest trace of this poison is sure death to the worm it touches. Hence,

4. *Apply the poison with great force.* If you do not do so, many apples which are concealed and protected by leaves will not be touched by the liquid. *Spray thoroughly, and at the proper time.* This is very important. If you are not posted as to the proper times for spraying, look the matter up in the Bulletins from this station, or write us regarding it.

5. Too much stress cannot be laid on the importance of the early or *first* spraying, before the caterpillars have entered the apples. If this be thoroughly done your late apples will be more free from worms.

6. Remember you have much rain here. If any rain whatever falls after your first spraying, spray again at once. In fact the rule is to spray three or four times during the season.

7. The young foliage here seems to be more tender than in the East, hence, dilute the fluid until leaves do not burn.

[*See Prof. Lake's remarks on these points* (*4, 5, 6*) *in the first article of this Bulletin.*]

8. Let every man feel it his duty to do his part faithfully, for the good of all.

DANGERS (?) IN USING.

A number of people have spoken to us of the possible danger in eating fruit treated with poisonous insecticides. To these we would say, there is no danger whatever if ordinary care be used. This has been proved again and again. We have heard of a few, a *very few* accidents in proportion to the wide-spread use of insecticides, and, in these cases, the cause could be traced directly to carelessness. Let us note cautions to be observed.

1. Keep the poison in a safe place, out of the reach of children, and others ignorant of its use. See that it is labeled " Poison " plainly. Never handle it with bare hands.

Use care yourself in handling the poison. If windy when spraying, keep to the windward side of the tree. It is well to use gloves, and to keep the liquid off your clothes as far as possible. See that your hands and face are thoroughly washed after such work. Keep children and thoughtless people out of the orchard when spraying is in progress, and for some time after. Do not let stock into an orchard fresh sprayed. Keep them out a week or two.

[It may be interesting here to cite Prof. Cook's experiment at Lansing, Mich. He allowed stock to eat clover freshly wet with the poison, and no ill effects were observed. Yet it is well to bear in mind, in spite of this observation, that you are dealing with a poison, and act accordingly.]

3. In dusting any dry poison onto vegetables, etc., see that the wind does not carry the dust to any berries or fruit near at hand which is soon to be gathered. Avoid this difficulty by not planting vegetables, likely to be treated with insecticides, so close to your berries.

4. Do not spray fruit shortly to be gathered, fall apples and pears, for

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instance. They ought not to be sprayed within three weeks of gathering. Save your late apples by observing condition No. 4 above, for thorough early spraying will greatly lessen the number of worms in the second brood which appears in the latter part of summer.

[*See Prof. Lake's article at the beginning of this Bulletin for observations on early spraying, etc.*]

5. Use whatever other precautions common sense may suggest.

It may be interesting to note, in connection with No. 4, that Prof. Forbes of Illinois has made some investigations to determine the liability of poisoning from eating sprayed apples too soon after spraying. In a lot of apples gathered ten days after spraying with Paris Green, chemical analysis showed that the amount of poison on one apple was such that seventy-four, if eaten, would convey a poisonous dose. The weather during the above period of ten days had been somewhat rainy and boisterous.

CONCLUSIONS.

If one observes a little care, as outlined above, there is practically no danger whatever in the use of insecticides. This has been repeatedly proved by careful experiments. Moreover, that insecticides, properly used, *can* and *do* protect a crop from insect pests, has also been repeatedly proved, and we cannot advocate their use too heartily.

One thing should certainly be borne in mind, *it is each man's duty to do his best in freeing his orchard from insect pests.* He owes it to himself, to those who come after him, to his neighbor, and to the State. Let no man sit idle while his neighbor works. It costs not much time nor money, and the reward is worth the striving for—an abundance of handsome, sound fruit. If an orchard is not worth such treatment it should be destroyed and replaced with good trees.

I add a list of some of the insecticides now in use:

They may be divided into two classes: (1) Internal poisons, taking effect on being eaten along with the ordinary food of the insect. (2) External irritants, acting from the outside—closing the breathing pores, or causing death by irritation of the skin. There are, too, other substances to be classed as insecticides, some keeping the pests away because of offensive odors, others acting simply as mechanical barriers.

(1) POISONS.

Paris Green is a chemical combination of arsenic and copper, called arseniate of copper. It contains about fifty-five or sixty per cent. of arsenic, and retails at about thirty cents per pound.

It is, practically, insoluble in water, and may be applied either dry or wet. In the former case it should be well mixed with some fine powder as a dilutant; plaster, unslacked lime, flour, road-dust, and finely sifted wood ashes all answer the purpose fairly well, though lime or plaster are usually preferable.

The proportion of poison to diluent varies greatly with different users—

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one part poison to fifty, and even one hundred, of diluent, will usually be effective, if the mixing be *thoroughly* done. In the wet mixture for shade and fruit trees use one pound of poison to 150 gallons of water. (This is for eastern foliage. See account of Prof. Lake's experiments with codling moth at this station.) It is well to be economical with poison, of course, and to use as small a quantity as is concomitant with success.

London Purple is a by-product in the manufacture of aniline dyes, produced by Hemingway's London Purple Co., of London, Eng. It contains nearly the same percentage of arsenic as Paris Green, and is much cheaper, retailing at about fifteen cents per pound. It is a finer powder than the green, and consequently remains in suspension much longer. It may be used in the same way—as a powder or in water—and the proportions given above answer very well for it. [This is for eastern foliage, see Prof. Lake's remarks on this point in first article of present Bulletin.]

White Arsenic is sometimes recommended, but fortunately rarely used. It is much more dangerous to have around than either of the above mentioned highly colored componnds, and is more liable to burn the foliage to which it is applied.

(2) EXTERNAL IRRITANTS.

Hellebore is a powder made of the roots of a plant called White Hellebore (*Verartrum Album*). It is a vegetable poison, but much less dangerous than the mineral arsenical poison, and kills both by contact and by being eaten. It may be applied as a dry powder or in water, one ounce to three gallons.

It retails at about twenty-five cents per pound, and is especially excellent for destroying the imported currant worm.

Pyrethrum is an insecticide of recent introduction, made from the powdered flowers of plants of the genus *Pyrethrum*. There are three principal brands upon the market, known as Persian Insect powder, Dalmation Insect Powder and Buhach—the latter being a California product, The greatest obstacle to the use of Pyrethrum has been the difficulty of obtaining the pure, fresh article. If exposed to the air the poisonous principle volatilizes and the powder is worthless. Hence dealers should purchase a fresh supply each season, and should keep in air-tight vessels. Pyrethrum is used mainly either as a dry powder, or in water (one ounce to three gallons); but may also be used in the form of a tea, or a decoction, a fume or an alcoholic extract diluted. For use as a dry powder it may advantageously be diluted with six or eight parts of flour.

Kerosene Emulsion is made by adding two parts of Kerosene to one part of a solution made by dissolving half a pound of hard soap in one gallon of boiling water and churning the mixture through a force pump with a rather small nozzle, until the whole forms a creamy mass, which will thicken into a jelly on cooling. The soap solution should be hot when the kerosene is added, but of course must not be near a fire. The emulsion thus made is to be diluted, before using, with nine parts cold water. This substance destroys

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a large number of insects, such as the chinch bug, cabbage worm and white grub; is a comparatively cheap and very effective insecticide.

Besides its use as an emulsion, kerosene alone is frequently used for various pests. It is especially valuable in destroying vermin on domestic animals and in hen houses.

Whale Oil Soap is a residue from bleaching whale oil. Costs in barrels about 3½ or 4 cents per pound. [See Prof. Lake on Woolly Aphis in this Bulletin, for its efficacy.]

Whale Oil Soap and Sulphur can be used where whale oil soap alone is used. For directions for mixing see article on Corn Worms in this Bulletin.

Carbolic Acid, especially in its crude state, is valuable for various insecticidal puposes. An excellent wash for preventing the injuries of several tree borers is made by mixing one quart of soft soap, or about a pound of hard soap, with two gallons of water, heating to boiling, and then adding a pint of crude carbolic acid. Carbolic acid soaps are largely used for destroying vermin on domestic animals.

Tobacco is a very valuable insecticide for use against vermin on domestic animals and green house pests. It may be used in the form of a decoction, or smoke, or dry. The refuse stems from the cigar factories are generally easy to obtain, and, if fresh, are effective in destroying the pests mentioned.

Bisulphide of Carbon is a volatile substance used for destroying grain insects, ants, the grape phylloxera, and other insects which may be reached by a vapor. It is inflammable and should never be used in the vicinity of a fire.

Benzine is another volatile substance used for the same purposes as the last.

Gasoline may also be mentioned in the same connection.

Coal Tar has been largely used in the West for destroying Rocky Mountain locusts, being placed on flat pans on which the insects jump and are caught. It is also employed to prevent the migrations of the chinch bug. A shallow V-shaped channel is made with the corner of a hoe along the borders of the field to be protected, and tar poured in. So long as the tar does not dry out, the immature chinch bugs cannot cross it.

Lime and Plaster are excellent in preventing the depredations of certain insects. Plaster may be dusted on melon and other vines to drive off flea beetles. (Wood ashes have been found good for this here at the station.) Fresh slacked lime may be dusted or sprayed (a peck to fifty gallons) on grapes, peaches, etc., to prevent rose-beetle injuries.

Your druggist or grocer probably carry the more common insecticides, or can get them for you.

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SPRAYING MACHINES.

F. L. WASHBURN.

The many inquiries from farmers relative to methods for applying insecticides calls for the following descriptive list and prices. We might say in this connection that with every machine there should be a return pipe of some description carrying at every stroke of the pump handle, in addition to the stream or streams playing upon the trees, another stream back into the tank or barrel holding the poison, thereby keeping the liquid thoroughly mixed.

[CAUTION: Do not have the nozzle at the return pipe with so large a hole that it takes from the spraying stream, lessening too much its force and volume. The nozzle should be just large enough to allow of a stream sufficient to keep the liquid, into which it empties, well agitated; in other words, to keep the poison from settling at the bottom.]

The machine used at this station, and giving satisfaction, is called the "Perfection" Spraying Outfit (see Fig. 1, adjoining.

It is manufactured and sold by the Field Force Pump Co., of Lockport, N. Y. The pump is fitted with ten feet of discharge hose and a graduating spray nozzle attached at "A". At the aperture "B" is attached three feet of return hose with discharge pipe at lower end. At every stroke of the pump a small part of the liquid is redischarged into tank near bottom of suction pipe insuring a thorough mixing of the poison and water. There is also a light cap furnished to close up opening "B" when desired. This pump has three inch cylinder and is furnished with iron suction pipe ready to mount on barrel or tank. Weight 55 lbs. The price of this outfit without barrel is $12.00.



FIG. 1.

Goldsmith & Loewenberg of Portland, Or., are agents for this pump and will furnish, on application, special rates to farmers needing this outfit.

We use this pump here, in the orchard, substituting a home-made tank in place of a barrel.

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The same firm, Field Force Pump Co., also carry the "Vermorel" Spraying Nozzle, which is an improved "Cyclone" nozzle. It is well spoken of. Price $2.00. They also manufacture and sell the "Graduating Spray Nozzle," price $1.00.

Another apparatus, said to be a good practical machine, is the Climax Pump, No. 2 (see Fig. 2), manufactured by the Nixon Nozzle and Machine

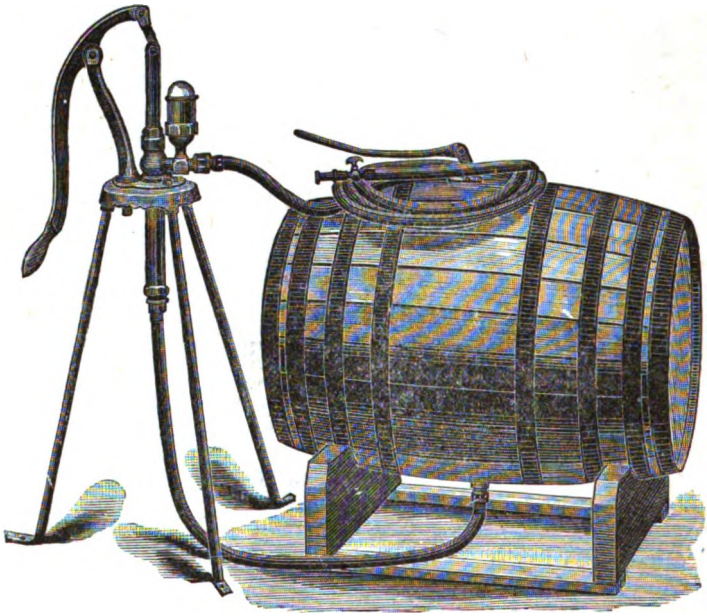


FIG. 2.

Co., Dayton, Ohio. Price $15.00. This includes the pump with twenty feet of hose, two nozzles and necessary connections. The barrel is not furnished. The pump can be attached to any kind of vessel or tank, by means of brass connections, in a few minutes. The "agitator" for keeping the poison mixed, the handle of which is shown at the top of the barrel, costs $1.00 extra.

Fig. 3, adjoining, shows the various parts of the excellent Climax Nozzle, very highly spoken of by Prof. Riley of the U. S. Agricultural Department at Washington, and commended by many others. No. 3 shows the outer end covered by a wire screen which cuts the water into spray. No. 2 shows nipple end of same. No. 1 shows the nozzle entire. The nozzles are simple in construction, cannot get out of order and are very durable, being made of brass. They are all fitted with standard-pipe thread and will fit corresponding sizes of gas pipe and hose coupling. They are made of vari-

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ous sizes, numbered from 1 to 6, and will produce spray from the density of fog to any desirable coarseness as may be required. Nozzles Nos. 1 to 5 are intended for conservatory, flower garden, orchard and field use. No. 6 is for lawn and street use. Prof. Riley says it is very well adapted for spraying high trees. The nozzle costs $1.00. It is manufactured and sold by the Nixon Nozzle and Machine Co., Dayton, Ohio. In all probability an agency for these nozzles and for the Nixon Spraying Machines will be established here.

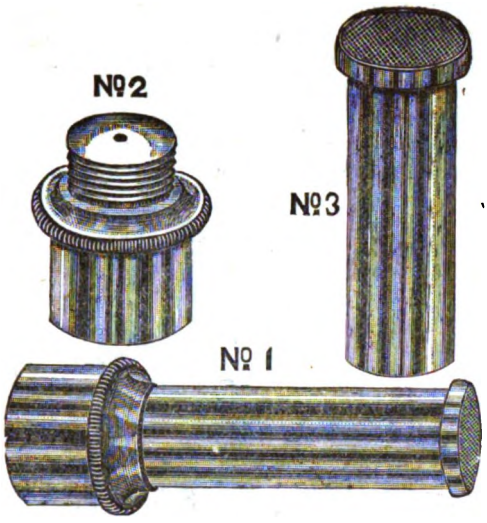


FIG. 3.

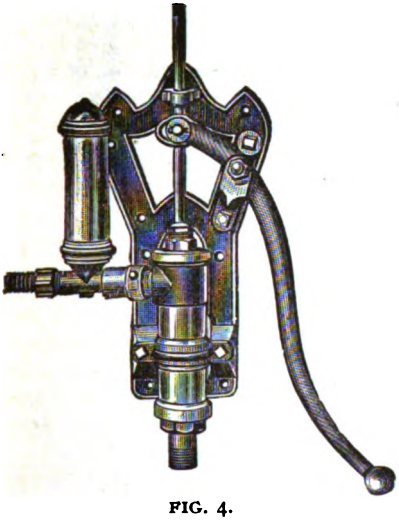


FIG. 4.

Fig. 4 illustrates the Gregory Spraying Pump, sold by H. P. Gregory & Co., San Francisco, Cal. It is reported as having a large sale. Prices are as follows:

Pump alone - - $17.00

Pump with Suction Hose and Strainer with 25 ft. of Hose and Bamboo Extension Nozzle with Spray Tip - - - $26.00

Pump with Suction Hose and Strainer, double discharge with two lengths of Hose, 25 ft. each, two Bamboo Extension Nozzles and Spray Tips - - - $34.00

Extra Rubber Plunger Pistons, each - - - - - - .25

Extra Disc - - - - .05

A special discount of 15 per cent. off of above prices is made to consumers.

The difference between the two above outfits is principally on account of the double length of hose, and the two extension nozzles. The double discharge referred to is a Siamese connection placed on the end of the outlet, for two lines of hose. This connection costs about 50 cents more than a regular hose coupling.

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This double discharge could be fitted to any pump, and if a short piece of hose from one of the outlets back into the barrel would answer as an agitator, the catalogue price would be something less than the above, the increase in price being due principally to the 25 feet of hose and spraying tips.

This firm prefer to furnish hose with their pumps, especially the suction hose, and in the above list they figure on the best quality. If purchasing parties prefer to buy their own hose, of course they can do so.



FIG. 5.

Ramsey & Co., of Seneca Falls, N. Y., offer the following:

The Florida Pump (Fig. 5), price $7.50.

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They also carry some cheaper machines adapted for small work and costing about five or six dollars each. (See Fig. 6.) They sell, also, the "Boss" and "Gem" nozzles.



FIG. 6.



FIG.

Fig. 9 illustrates the method of using a machine for which E. J. Dunn, of Corvallis, Or., is the agent. It is said to do effective work with small fruits and flowers. Price, $2.00.

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Figs. 7 and 8 adjoining show methods of using spraying pumps and illustrate two pumps carried by Wooden & Little, of San Francisco, Cal. These pumps cost $16 and $18 respectively. The first pump figured is made entirely of brass, except frame and handle. This firm also carry a large assortment of other farm machinery.

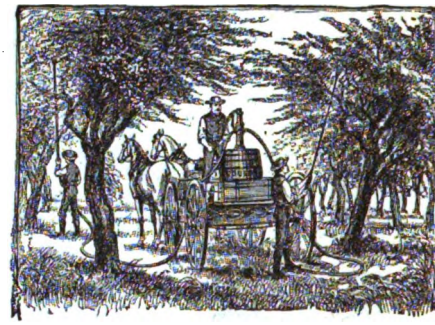


FIG. 7.

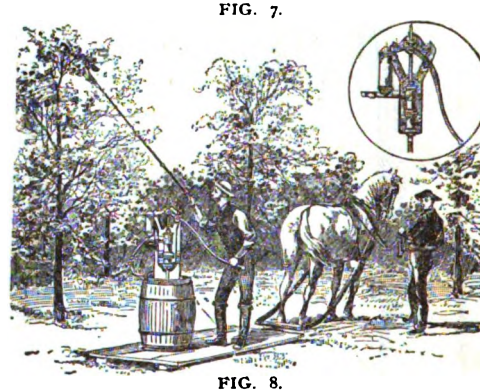


FIG. 8.

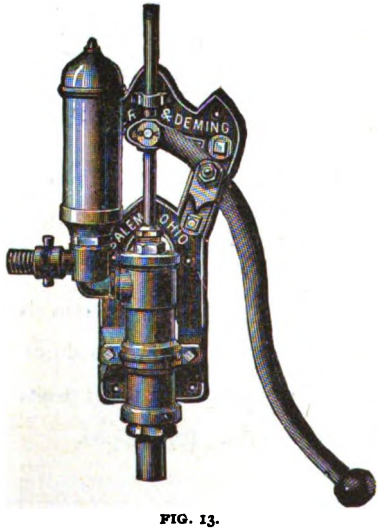


FIG. 13.

Fig. 13, adjoining, shows the Horticultural Spraying Pump, for sale by the same firm, Baker & Hamilton. It is furnished with a 2-in. bore, 1-in. suction, ¼ in. discharge. All the working parts are brass. Price $11.25. They are all well spoken of.

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Fig. 10 and Fig. 11 illustrate the Farmers' Force and Spraying Pumps, Nos. 1 and 2 respectively, sold by Baker & Hamilton, San Francisco and Sacramento, Cal. They weigh from 30 to 40 lbs.

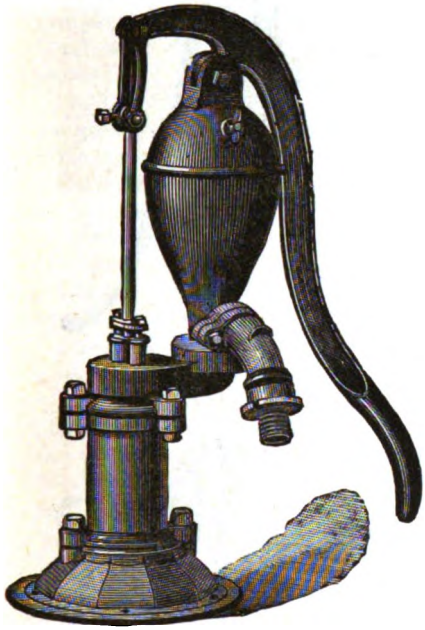


FIG. 10.



FIG. 11.

PRICES.

No. 1,	3 inch iron cylinder, fitted for ¼ inch hose - - - - - - -	$6.00
No. 2,	" " " " " - - - - - - - - -	6.75
No. 3,	" brass " " " " - - - - - - -	9.00

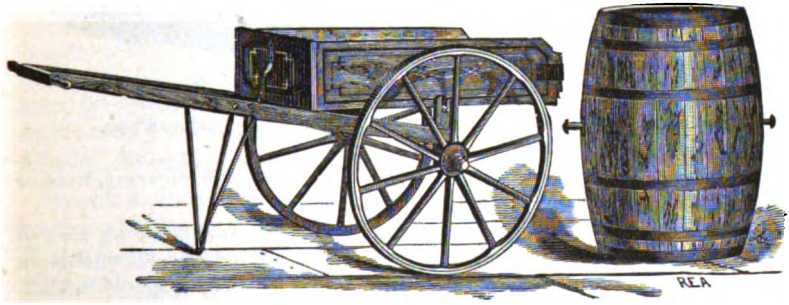


FIG. 12.

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Fig. 12 shows interchangeable cart-box and barrel for accompanying two-wheeled cart. Sold by the last mentioned firm.



FIG. 14.

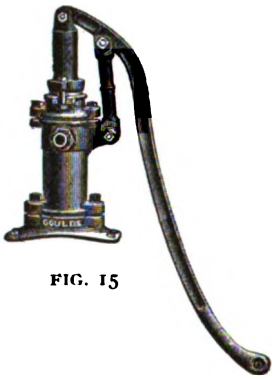


FIG. 15

Fig. 15 shows Gould's Double-Acting Spraying Pump. Fig. 14 shows the pump fitted with hose and discharge pipe. Fig. 16 shows the same fitted with gas pipe and spreaders. The pump will fit either side or head of barrel. Either of the discharges can be utilized as a return pipe to mix contents of barrel.

PRICES.

No. 2, Diam. of outer cylinder 2½ in. Suction 1 in. Double Hose Discharge ¾ in. Double Pipe Discharge ½ in. All brass piston or smaller cylinder and brass outer cylinder, $14.00



FIG. 16.

All brass piston, a smaller cylinder and iron outer cylinder, $8.50.

With metallic fitted lower valve, $2.50 net, extra.

These prices include a brass suction basket, but no pipe, sprayers, hose or couplings.

These pumps are manufactured by The Goulds Manufacturing Co., of Seneca Falls, N. Y. The John Barrett Co., of Portland, Or., are agents in this State, and Messrs. Woodin & Little, of San Francisco, agents in California. The Goulds Co. advertise to furnish any fittings, as ordered at the

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lowest market rates. Fig. 17 shows the method of using the above pump, fitted with gas pipe and spreaders, in a field of vegetables. See also Fig. (a) for method of using the same pump fitted with double hose, in orchard.

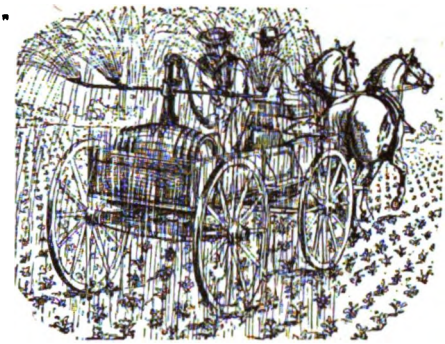


FIG. 17.

In the case of most of the pumps offered by the various firms quoted in this Bulletin it is probable, even where no mention is made of this fact, that a double connection (i. e. for two pieces of hose) could be fitted to the outlet at little extra expense, affording thereby a return pipe for keeping liquid well mixed.

The above by no means exhausts the list. The Field Force Pump Co. also carry a "Duplex" spraying outfit for hand power with two separate discharge pipes, enabling one to spray two rows of trees at once; or one pipe may be returned to the tank, furnishing a return stream to keep the poison mixed. This outfit, consisting of pump, two eight-foot sections of Discharge Hose and two nozzles, with 2¾ feet of suction pipe, costs $14.00. Weight of outfit 62 pounds. They also carry elaborate spraying outfits mounted on wagons, where the pumping is connected with and accomplished by the revolution of a wagon wheel, i. e. by horse power. One of these machines with return pipe, one discharge hose(two cog wheels, crank and crank shaft, boxes and connecting rod, with bolts to attach to pump and to framework of wagon (wagon, of course, not furnished), costs $30.00. A discount is given from this price on application. This apparatus is called the "Victor." Another, the "Orchard King," with two discharge pipes and a return pipe, is quoted at $36.00. The "Victor" outfit weighs 150 pounds, the "Orchard King" 165 pounds.

The Nixon Nozzle and Machine Co., of Dayton, Ohio, make what is known as the "Barrel Machine." The barrel to which the pump is attached is placed on runners and designed to be drawn by one horse. The handle of the agitator is attached to pump handle; the act of pumping stirs the liquid in barrel. Price $35.00. The "Little Giant," made by the same firm, is essentially the same as preceding, but instead of a barrel there is a tank mounted on wheels, to be drawn by hand, or detached and placed on wagon. Price $35.00.

Staver & Walker, of Portland, Or., carry a large line of farm machinery, among other things, a $35.00 Spraying Pump, known as "Bean's Patent." This machine is furnished with an air cylinder, which by pumping can be filled with compressed air, allowing, when so filled, one man to leave the pump and direct the spray. This can be furnished with two discharge pipes

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at an additional cost. Although this is an expensive pump, it certainly promises to be effective, and its labor saving properties should induce an investigation. In this case, as in the case of other high-priced pumps, two or three or more farmers might, with profit, combine in purchasing.

DIRECTIONS FOR SENDING INSECTS.

All inquiries about insects, injurious or otherwise, should, if possible, be accompanied by specimens. Such specimens, if dead, should be packed in cotton or wool and inclosed in a stout tin or wooden box. They will come by mail for one cent per ounce.

INSECTS SHOULD NEVER BE ENCLOSED LOOSE IN A LETTER.

Whenever possible, larvæ (i. e. grubs, caterpillars, maggots, etc.,) should be packed alive in a tight tin box along with a supply of their appropriate food, sufficient to last them on their journey. Otherwise they generally die on the road and shrivel up. Send as full an account as possible of the habits of the insect under discussion; for example what plant or plants it infests; what part of the plant suffers from its attacks; how long it has been known to you; what amount of damage it has done, etc. In sending soft insects or larvæ that have been killed in alcohol they should be packed in cotton saturated with alcohol. PACKAGES SHOULD BE MARKED WITH THE NAME OF THE SENDER and should be addressed to entomologist.

In connection with these directions we should like to call attention to the fact that local soil, local climate and other conditions influence to so great an extent the effectiveness of remedies against insect depredation, that what may be true for many places, and what is cited as a general truth by excellent authorities on Entomology, may not be so desirable or effective in Oregon. This being the case, and in view of a proposed work on injurious and beneficial insects of this state and the remedies best suited to local conditions, we would appreciate fully communications relative to any remedy or remedies proved, beyond question, to be effectual here, especially such as are not mentioned in works on insects, and we would also like to hear of remedies which fail in this state though found effectual elsewhere.

Such information and contributions of specimens of insects would be valuable aids in compiling a treatise on Oregon insects.

F. L. WASHBURN, Entomologist.

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PLANTS POISONOUS TO STOCK.

The commencement of some investigations, having as their object the determination of those plants of Oregon which are poisonous to cattle, with an idea to their description, analysis, etc., by P. H. Irish. The present paper is not written with the purpose of giving any results of finished work, but that the subject of the work may be brought to the notice of the farmers to gain their cooperation in carrying it out.

The matter was taken up on account of numerous letters received at the station during the spring and summer asking information with regard to plants which were thought to be poisonous to stock. The method of investigation was the following: Two well developed, healthy yearling steers were bought for the experiments, which were primarily to discover whether the plants under examination were injurious, and if so to note the symptoms developed and try various antidotes for the effects produced. That all parts of the plants might be tested, the tops, i. e. the leaves and stem were fed to one animal, the roots to the other. As great a quantity of the plant was fed to each as cattle under ordinary circumstances would be liable to obtain in the pasture. That the plants might be readily eaten they were, in most cases, mixed with some chopped grass and a small amount of oats added. The experiments commenced May 7, and the first plant tried was the common blue lark spur (*delphinium exaltatum*).

Twenty-four specimens of this were taken. The tops chopped and mixed with about an equal amount of clover grass, were fed to one, the roots prepared in a similar way, were fed to the other animal, in both cases without any apparent ill effect. The larkspur used was mostly in full bloom and the individuals were chiefly good sized plants.

White larkspur was next tried. Thirty plants, well developed, in full flower, were fed in a manner similar to that noted with the blue larkspur. No effect noted.

Cammers, which had also been reported as poisonous, was now tried with no ill effect upon the steers.

Next came the plant which as far as I can learn has no common name the scientific name of which is Sanicula Horrellii. Forty young plants, i. e. those not yet in bloom, were fed. The only effect noticed was that one of the steers was slightly physicked.

Degenerated parsnip. The tops from thirty-five parsnips were fed and the roots from one-half of this number; with no apparent ill effect.

The last experiment was with the common cow parsnip. This yielded the same sort of negative results noted in the preceding, the animals which were fed five large plants still remaining healthy and hungry.

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The results given above would seem to prove without doubt that the plants experimented with are not poisonous to cattle at that stage of their growth at which they were when made use of, and as these are the ones generally suspected of causing the loss of stock every summer, it would seem that either they are suspected wrongly or else they have no effect when as far advanced as were these specimens. During the next spring and summer it is proposed to carry on the investigation, taking the above plants, and as many more as shall be reported as dangerous, and testing them from the time when they first appear in the spring until they are fully matured. In order that we may find out just what harmful plants we have in the State, which should be eradicated from the pastures, we would ask that every man who has a theory or an idea as to what it is that causes so much loss to cattlemen every spring would write to us and give us the benefit of those ideas or theories, that we may by practical test be able to prove them true or false. We would ask everyone who has had any experience in this line to write and tell us what he knows about the subject, how his cattle were affected what remedies, if any, were made use of, and what their effects were.

Address all communications on the subject to

P. H. IRISH, Chemist Exp't Station,
CORVALLIS, OREGON.

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OREGON

Agricultural Experiment STATION.

BULLETIN NO. 4.

DEPARTMENT OF AGRICULTURE:
Notes on Farm Crops.

DEPARTMENT OF HORTICULTURE:
I.—Notes on Vegetables.
II.—Ornamental Trees and Shrubs.
III.—Orchard and Small Fruits.

DEPARTMENT OF CHEMISTRY:
Wheat, Mineral Waters, Apparatus, Soil Analysis, Etc.

JANUARY, 1890.

The Bulletins of this Station are sent free to all residents of the State who request them.

SCHWAB BROS. PRINTING AND LITHO. CO., PORTLAND.
1890.

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NOTES ON FARM CROPS.

E. GRIMM.

CONDITION OF SOIL.

The soil upon which the crops were grown had been used for a pasture for six or seven years and from continued tramping of the animals had become very hard and uneven.

The land was given a shallow plowing during the summer of 1888 and again plowed and sub-soiled in the fall and winter. On account of the very firm condition of the soil it broke up in large clods, which had to be broken by hand, and in some instances, when it was not practicel to break them, they were removed by hand raking. Thus it will be seen that the conditions were not the most favorable for testing farm crops. Besides the unfavorable conditions due to rough treatment, by allowing stock to tramp it while wet, there were even greater difficulties to overcome inherent in the soil itself. Through the central part of the farm extended a slough, of about 8 acres, generally known as "white land." It was therefore necessary, before much could be done, to thoroughly drain the field. An open 4 ft. drain, running north and south, was cut through the farm into which emptied the two four inch mains running on the north and south sides of the field. Three inch tiles were laid at the depth of 2, 3 and 4 feet and sixty feet apart empting into the two mains. Twelve acres of the land was drained in this manner. Owing to the lateness of the season the land could not be brought into even tolerable condition for planting till February, 1889. The land was then platted and most of the drained portion used for the purpose of testing the different grasses, clovers, forage crops and the cereals. These plats were mostly on the higher portion of the farm, with the exception of the grass and clover plats, which were intended as test plats on the white soil. There was in all 112 plats, of this number 67 were grasses, 10 clovers, 7 forage plants, 13 wheats and 15 oats.

GRASSES.

The grass plats are all in good growing condition, and although the past summer and winter has been as severe as is usually experienced in the Willamette Valley, we have not a single failure to record from our plats with the exception of *Bromus Schraderi* (Rescue grass) and this was due to poor soil.

Commencing with the fescues we find that *Festuca pratensis* (English blue grass) and *Festuca elatior* (Tall fescue) made vigorous growth, were unchecked by the summer's drouth and are now standing from 8 to 10 inches high. All the other fescues have done well with the exception of Festuca duriuscula which gave a very thin stand. The finer grasses such as the small fescues, *Poa Trivialis*, *Poa Nemoralis*,

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the different species of Agrostis and Alopecuris were less marked in their growth, yet have done well, in most cases forming a good sod and giving promise of splendid results the coming season. *Alopecurus pratensis* (meadow fox tail grass) is deserving of special mention as an early grass and worthy of forming a part of mixtures for permanent pastures. It has done well on the plats but requires three or four years to become thoroughly established.

The Brome grasses have done well with the exception before mentioned.

Bromus inermis (Awnless brome grass) is highly recommended as a forage plant especially adapted to light dry soils. On the plats it has done remarkably well. It was planted in February, ripened seeds and then threw up leafy shoots 18 inches in height. It has every appearance of being a valuable grass and worthy of more extended trial. These grasses flourish only on rich soil.

Holcus lanatus (meadow soft grass, mesquit grass) does well wherever sown. It is an early grass, makes a quick growth and thrives well where many other grasses do poorly. This grass has an undeserved popularity, as it is not relished by stock, either when green or in hay, being too soft, spongy and insipid.* Its value in any locality will depend upon whether the better grasses will or will not grow there. It should be sown only after proving, by actual trial, that other grasses will not do well. Although of vigorous growth and adapted to almost any soil it must be classed as inferior.

Dactylis glomerata (orchard grass) is a valuable grass which grows to perfection with us. It deserves the careful attention of the practical farmer. For an early, hardy and vigorous growing grass which is relished by stock, none will outrank this grass. It has shown its adaptibility to our soils and climate by its spreading over the Willamette Valley from farm to farm, taking possession of fence corners and orchards in many localities. Properly handled this grass must grow in the estimation of the farmers. As a grass to sow with clover it is preferable to timothy as it flowers earlier and is ready to cut at the same time as the clover.

Arrhenatherum aoenacum (Tall oat grass) (Avena Elatior) (Lincoln grass). This is a grass highly recommended by those who have tried it in this state. On the plats it has sustained its reputation as a hardy, quick grower. It was sown Feb. 9, 1889, was in head May 26, and gave a heavy cutting of hay and then threw up leafy shoots making a strong effort to form a second crop of hay. The after growth was excellent. As a hay plant it is probably inferior to timothy and orchard grass and will be outranked by several grasses for general pasturage. It is however deserving of more extended trial and study.

Lolium perenne and Lolium Italicum, (Rye grasses) have done remarkably well with us, leaving nothing to be desired which could be expected from what has been written and said concerning their habits of growth. Lolium Italicum started more vigorously than L. perenne and maintained its lead during the summer but at this time L. perenne shows a better stand and has a hardier appearance. In our moist climate with comparatively cool summers, these grasses give promise of doing as well as in parts of Europe where they are so highly valued.

*Beal's grasses of North America Vol. I. page 193.

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Phleum pratensis, (Timothy). This well known and popular grass has done well on the plats but gave a poorer stand than the orchard, English blue, velvet and rye grasses. For the production of hay this is the most popular if not the most profitable grass for Western Oregon. Its many good qualities as a hay crop has kept in the back ground some of its defects which must count against it as a pasture grass, for which purpose it is so extensively sown in the Willamette Valley. It starts slowly in the spring ; its tuber at the base of the stalk is injured by close feeding, by the tramping of stock, by frost and by drouth. It is only profitable to grow as a hay crop.

Cynodon Dactylon, (Bermuda grass). This is a valuable grass for the Southern states and was tried on our plats last year. It started to grow very late and made but little growth till after the other grasses had made considerable advancement towards heading. During the drouth it seemed to flourish best. It threw out branches 3 feet long, making a perfect sod over the plat, but was cut back to the roots by the frost in December. It is not a good grass for this climate.

Poa Arachnifera, (Texas blue grass). Plants of this grass were obtained from the Kansas experiment station and planted October, 1888. From the time of planting to date this grass has grown rapidly, throwing out numerous shoots from its rootstocks, completely filling the spaces between the rows. This is a very promising grass, having the marks of Kentucky blue grass, but more vigorous, larger leaved, and gives promise of being a most valuable acquisition to our list of grasses. It will be tested in Eastern and Southern Oregon the coming season where there are reasons for thinking it will prove a most valuable grass. "As far North as Kansas Prof. Shelton says it endures the winters and resists drouth perfectly, making three or four times as much pasture and hay as does its near relative Kentucky blue grsss.* "

It is not our intention to place the quick growing, large leaved grasses to the front as superior to the slow growing, fine leaved grasses of the plats. What has been said of vigor, growth, etc., must not be interpreted as placing these grasses as superior to, or in some cases, equal to the less rapidly growing ones which require more time for their full development. In a mixture of grasses, and there should always be a mixture of several kinds sown for pasture, care should be taken to secure those grasses, both in amount and kind, which will insure a varied and continuous pasturage during the year. This would bring in many of the plants which would give their best results after the second or third year. A grass is not to be judged wholly by what is seen above the ground, as often the root formations are of the greatest importance.

After twenty years of experimenting with grasses, Laws of England finds that the means by which they maintain or improve their position or succumb in competition with other grasses or plants, where grown in association, will depend upon their power of resisting drouth or frost, their period of growth, their roots and root hairs, root stocks, etc.

It is evident that a more extended study of our grasses is necessary, and it is the intention of the Station to make a thorough study of the native and cultivated grasses under such conditions of farm practice as will bring out their true value.

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*Beal's grasses of North America Vol. I, page 143.

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CLOVERS.

The clovers were sown in the spring with the exception of two plats, one of red and one of Alsike, which were sown in October, 1888. The great trouble in growing clover in this section seems to be in securing a "catch." It is claimed that with fall seeding the clover is killed by freezing and thawing, while spring seeding is dangerous on account of drouth. We are convinced that the trouble is not so much in the seasons as in the mechanical condition of the land. For clover, the ground must be thoroughly prepared. By thoroughness is meant that the land must be well drained, finely pulverized, and the seed bed be of fine earth, as free from clods as possible. With land in good condition there is but little danger of drying out in the summer and if sown in February, all danger from frost is past. All the clovers did well and yielded a fair crop, the common red and alsike giving the best returns. *Trifolium Incarnatum* (French clover), (Crimson clover), gave a light yield, growing to the height of 12 in. and was less affected by the dry summer than any other clover grown. This is a beautiful plant but of doubtful agricultural value for this state. Failure to secure a stand of clover in the Willamette Valley, means in most cases, poorly drained and cultivated soil, as no plant does better than the clovers in this section. This is evidenced by the growth of our native clovers such as *Trifolium microdon*, *T. involucratum* and others which grow to the height of 2½ feet in our fields. Indeed there is every evidence of this being a most excellent clover country, and with due care in the preparation of the land no more trouble need be experienced here in growing this most valuable crop than in the most favored localities.

GRASSES AND CLOVERS ON THE "WHITE LAND."

Perhaps some explanation of the term white land is necessary. By white land is meant a heavy clay of whitish color usually covered, or saturated with water during the winter and spring months, destitute of natural drainage and it is generally the lowest portion of an extensive tract of comparatively level country. It yields a light pasturage of native grasses where undisturbed by the plow. There is a large amount of this land in the Willamette Valley which is giving but small returns to the farmers who attempt to cultivate it. It is considered of inferior quality for farm or pasture land. Wheat and oats do not fill well on this land and the grasses which grow upon it are some varieties of the *Agrostis*, (Red top) *Airas*, (Hair grass), and *Alopecurus*, (Fox tail), which are of an inferior quality and afford but a scant pasturage for stock. The great trouble with this land is excessive moisture, and the remedy is thorough drainage and careful cultivation. The plats which were seeded for the purpose of testing the capacity of this land for growing grasses, have so rapidly changed their color that by another year we cannot use the term white land to designate them. Drainage and grasses have prevented the waste of organic matter and this "pale faced" land is taking on a healthy color, giving a liberal response for labor expended upon it.

Thirty-one plats were seeded on this land, 26 grasses and 5 clovers,—plats of 1–40 acre each. The land was thoroughly drained in the fall of 1888, and did not become excessively wet during the winter and spring. As is usually the case this land was not plowed in the spring, till after the higher portion of the field had been seeded, on

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account of its being much slower to dry. It was plowed, thoroughly pulverized and when necessary hand raked to remove clods. One characteristic of this land is, if put in condition to receive the finer seeds, such as that of the grasses, there is danger of rain followed by sunshine, which causes the soil to bake, greatly to the injury of the young plants. This may be partially corrected by rolling the land. We prepared the ground the second time, for seeding, on account of rain, followed by sunshine, causing the land to become very hard and cloddy. Too much cannot be said in favor of careful and thorough preparation of this land, for failure here, means a total loss of labor and a most valuable crop of grass.

The grasses deserving special mention as doing well on this land are Orchard grass, Tall Oat grass, *Festuca pratensis*, *F. elatior*, Italian and Perennial rye grasses, Velvet grass, (*Holcus Lanatus*) and Timothy.

These grasses have shown remarkable growth making a splendid sod. During the dry summer the Rye grasses and Orchard grass were affected by drouth but quickly recovered. The Fescues continued to grow all summer and at present writing are doing well, showing a growth of 6 to 18 inches. The finer grasses such as the Agrostis, smaller fescues, Crested dogstail, etc., have all done well but it will require another year for them to reach their highest perfection. As a mixture with the coarser, large seeded grasses, any of these smaller grasses might be desirable to fill up the vacancies which usually occur among the coarser grasses after a year or two. From some experiments made with a mixture of grasses on "white land" which was prepared entirely by horse power, we are convinced that the large seeded grasses must be depended upon for the first few years after draining this variety of soil. White land has peculiarities which must be carefully observed if we successfully handle it. Of all soils, this passes most rapidly from the too wet to the too dry state. No amount of working with the ordinary farm implements can get a good seed-bed out of this land when it has passed over, even a few hours, the most favorable time for its cultivation. It breaks up into innumerable clods after a few hours of sunshine, showing a lack of organic matter in its composition. In consequence of this we would not, even under the most favorable conditions, on the average farm, recommend the finer grasses for this land for the first or second years.

Our land was as poor as could well be found in the Willamette Valley, but was carefully and thoroughly prepared, and yet of the whole number of grasses and clovers sown only the brome grasses failed. A mixture of grasses and clovers, comprising all the varieties left over after sowing the plats, was sown on a strip of white land, undrained, except by the large open ditch which ran along one side of it. No results were expected of any value as the sowing was not done until after the middle of April, the object being to make some use of the land to fill vacant space. The land was indeed white, yet the stand of grasses and clovers could scarcely be excelled withstanding the drouth of the summer and the winter freezing, as well as those on the higher grounds of the farm. The indications are that this is a most wonderful grass country, and when the farmers once become fully awakened to the value of their land for grasses and clovers, wheat growing will take a secondary position in the Willamette Valley, which in time, will be the home of the grasses and clovers and that in their highest perfection.

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FORAGE CROPS.

Reana luxurians (*Teosinte*)—This plant originally came from Central America, and growth it resembles Indian corn. On the plats it gave a very light yield, forming large stools but spreading flat upon the ground. For our climate and soil it is a failure, but for Eastern and Southern Oregon it may be of value as a soiling crop.

Spurry—An annual plant which is said to do best on sandy soil and used to feed either in the green or dry state. It made an excellent growth, yielding at the rate of twenty tons per acre of green fodder. When offered to cows it was refused, which was perhaps due to an abundant supply of more palatable food which they were accustomed to receive. The trial was made by a neighboring farmer.

Seradella—Seeds were sown in drills, about eight inches apart. Seed sown too thick in the row to get the best results. It grew remarkably well throwing out branches 40 inches long. It commenced to bloom June 10th and continued to bloom till December when it was killed by freezing. This plant is worthy of a more extended trial and may prove of value in the dryer sections of the state.

Madia sativa—This plant is recommended by some Eastern seedmen as good for sheep pasture. It is a worthless, gummy weed commonly known as "tar weed."

Sorghum Halapense, (Johnson grass)—This is a coarse perennial which may be propagated by rootstocks or seeds. Two plats were tried last season with good results. The seeds germinated well and the plants grew vigorously during the whole season until cut down by the heavy frosts in December. The rootstocks were uninjured by the frost and a heavy stand will probably be secured the coming year. It grew to the height of 4 feet, giving a good yield but it is of doubtful value in the Willamette Valley. It may prove of greater value in other sections of the state and is worthy of trial. As a pasture grass or as a hay crop it is too coarse, but for a soiling crop may have great value.

Onobrychis sativa, (Sainfoin, Esparsette)—A leguminous plant, which has made a moderate growth on the plats. It is too early for us to give an opinion of its value, as it will require another year for it to reach its best conditions.

Vicia sativa, (Spring vetches or Tares)—Seeds of this plant were sown March 1st, and plants were ready for feeding July 1st. This plant when grown alone falls upon the ground and therefore should be sown with oats. It gave a good yield of splendid feed. All kinds of stock relish this plant when fed to them and it should be more extensively grown. The native vetches grown in this state are especially worthy of trial. The vetch or pea vine, as it is commonly called, is represented by several species growing in the Willamette Valley and adjoining mountain ranges forming the natural pasturage of highest value in the coast range. It is proposed to make these and other native forage plants special objects of study at the Station.

In this work, all interested in the study of these plants, as to their economic value, are earnestly asked to collect seeds of any promising plants and forward them to the Station. The millions of acres of land in Oregon which are and must continue to be used for pasturage must impress all with the importance of a careful study of the plants which naturally grow in these sections.

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GRASSES, CLOVERS, AND FORAGE PLANTS GROWN AT THE STATION.

No. Plat.	Name of Variety	Common Name.
1	Agrostis Canina	Rhode Island Bent Grass.
2	" Stolonifera	Creeping Bent Grass.
3	" Vulgaris	Red Top.
4	Alpecurus Pratensis	Meadow Fox-tail.
5	" Agrestis	Slender M. Fox-tail.
6	Ammophila Arenaria	Beach Grass.
7	Aira Cæspitosa	Hassock Grass.
8	" Flexuosa	Wood Hair Grass.
9	Anthroxanthum Odoratum	Sweet Vernal Grass.
10	Avena Elatior	Tall Oat Grass.
11	" Flavescens	Yellow Oat Grass.
12	Cynodon Dactylon	Bermuda Grass.
13	Festuca Pratensis	English Blue Grass.
14	Poa Pratensis	Kentucky Blue Grass.
15	Bromus Pratensis	Meadow Brome Grass.
16	" Mollis	Soft Chess.
17	" Schraderi	Rescue Grass.
18	Cynosurus Cristatus	Crested Dog-tail Grass.
19	Dactylis Glomerata	Orchard Grass.
20	Festuca Duriuscula	Hard Fescue.
21	" Elatior	Tall Fescue.
22	" Heterophylla	Various Leaved Fescue.
23	" Ovina	Sheep's Fescue.
24	" Rubra	Red Fescue.
25	" Tenuifolia	Slender Fescue.
26	Holcus Lanatus	Soft Meadow Grass.
27	Lolium Italicum	Italian Rye Grass.
28	" Perenne	English Rye Grass.
29	Phalaris Arundinacea	Reed Canary Grass.
30	Panicum Germanicum	Hungarian Grass.
31	Pleum Pratensis	Timothy.
32	Poa Aquatica	Water Meadow Grass.
33	" Compressa	Canada Blue Grass.
34	" Nenioralis	Wood Meadow Grass.
35	" Serotina	Fowl Meadow Grass.
36	" Trivialis	Rough Stalked Meadow Grass.
37	" Arachnifera	Texas Blue Grass.
38	" Sorghum Halepense	Johnson Grass.
39	Alfalfa	Lucerne.
40	Trifolium Hybridum	Alsike Clover.
41	" Incarnatum	Crimson.
42	" Pratense	Large Red.

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43	Trifolium Repens	White Clover.
44	Medicago Lupulina	Black Medic
45	Melilotus Alba	Bokhara Clover.
46	Lespedeza Striata	Japan Clover.
47	Lupinus	Lupine, White, Yellow and Blue.
48	Madia Sativa	Sheep Fodder.
49	Onobrychis Sativa	Sainfoin.
50	Reana Luxurians	Teosinte.
51	Seradella	Sheep Fodder.
52	Spergula Arvensis	Spurry.
53	Vicia Sativa	Spring Vetches.

NOTES ON VARIETIES OF WHEAT.

The soil on which the wheats were grown was of average quality, thoroughly prepared by hand and seeds sown with garden drill. Seeding was done in February and March. The soil was not uniform as was shown by the uneven growth on individual plats. No attempt has been made, therefore, to make any comparative report of the yields. The demand for white wheat, which brings several cents per bushel more in the market than does the red, has to a great extent stopped the growing of the often better yielding red wheats. Whether this is based upon actual values of these different varieties or upon a prejudice will be carefully studied at the Station. Of the red wheats which are promising and which can be recommended are, Mayflower, New York Spring, French Imperial and Bli De Bordeaux.

The first three are spring wheats, and but one objection can be urged against their being extensively sown and that is their color which ranks them three cents per bushel below the white wheat in our market. The Bli De Bordeaux is a remarkable wheat, giving good yield with very large, plump, heavy grain; color lighter than in many of the other red wheats. In the case of the white wheats there was no marked superiority, except in case of the Foisy. The following is a brief history of this wheat as given by Hon. J. Voorhees of Woodburn: "It originated on a farm adjoining mine, in this way. About twenty-five years ago M. G. Foisy noticed a head of Red Chaff wheat, in his field of White Chaff wheat, of unusual size and gathered it, planted it in his garden until he had a sufficient amount to seed a small field. Its increase was rapid, exceeding other kinds that he was raising and it was more prolific than its appearance would indicate. In fact we are always agreeably disappointed when harvesting it. It is a spring wheat, head rather long, the boles not very close together inclined to straw fall when ripe, therefore not liked by those who use headers, requires thicker seeding than the old fashioned White winter wheat, and will out yield any winter wheat I know of when the winters are mild. This is especially noticeable when seeding on stubble or on our light prairie soil. Many of my neighbors sowed it this last fall in preference to Landreth wheats and it is the spring wheat of this prairie, (French Prairie). Mr. Foisy, who was a Frenchman, was too modest to call it after his name, but insisted that it was Oregon Red Chaff yet there is no one about here that knows it by any other name than Foisy."

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WHEATS GROWN AT THE STATION.

NAME OF VARIETY.	No. Plat	WHERE OBTAINED.	REMARKS.
French Imperial	1	R. G. Buchanan Benton Co.	Chaff light, heads loose, bearded, berry amber.
Percy	2	" "	Red chaff, bald, berry white.
Defiance	3	" "	Chaff light colored, bald, white flinty berry.
Okanagan Val. velvet chaff	4	J. A. Salzer, Wis.	White chaff, blue stem, bald, amber berry.
Assiniboia Fife	5	" "	Chaff white, beards short, amber berry.
Saskatchewan Fife	6	" "	" " bald, amber berry.
White Russian	7	Jas. M. Thorbum, N. Y.	" " " " "
Scotch Fife	8	" " "	" " beardless, amber berry.
New York Spring	9	" " "	" " bald, amber berry.
Foisy	10	M. Schneur, Yamhill Co.	Red chaff, bald, white plump berry.
Mayflower Spring		M. Wyatt, Benton, Co.	amber berry.
Bli De Bordeaux	11	Chas. Nicholson, "	Red chaff, bald, amber berry, very plump.
	12		
Spring Wheat	13	C. Davis, Benton Co.	White plump berry.

LIST AND NOTES ON VARIETIES OF OATS.

Varieties—Black Winter, Kansas Black Winter, Clydesdale, Early White Dakota, Hagetts White Seizure, Improved American, Monarch of New Zeland, New Race Horse, White Canada, White Wonder, White Russian, White Winter Kansas, White Bonanza, Welcome, White Dakota.

For lack of facilities there was no record made of the yield of straw and grain The work will be repeated during the coming season giving full notes in this particular.

Some of the varieties tested made remarkable growth and will no doubt prove a success in this climate. The White Wonder made a very good showing both in straw and grain. The heads were long, spreading and well filled. It is a barley oat and very heavy. The Clydesdale, New Race Horse, Monarch of New Zeland, White Seizure, White Bonanza and Welcome are very similar and all did equally well.

The Black Winter promises to be a valuable oat for this latitude although it has the objectionable feature of being a dark oat. The straw of this variety is strong and has a vigorous growth of leaves which would make it more valuable for stock food.

BUCKWHEAT.

Of the Buckwheats grown the Japanese is far superior to any of the other varieties both in yield and in vigor of growth. There was no rain to speak of from date of sowing until it was nearly matured yet the Japanese variety gave a very good yield of very plump grain. The Silver Hulls and Common Black suffered very much more from the drouth and failed to mature a very large proportion of the grain that formed. From the growth which the Japanese made we would feel warranted in recommending this variety in preference to any other. It has been demonstrated without doubt that the flour made from this variety cannot be excelled.

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VARIETIES GROWN.

Japanese,—seed obtained from . . . . . F. A. Horning, Benton Co.
European Silver Hull,—seed obtained from . . . . . Jas. Thorburn, N. Y.
American Silver Hull,—seed obtained from . . . . . " "
Common Black,—seed obtained from . . . . . " "

NOTES ON VARIETIES OF CORN.

The soil on which the corn was grown is heavy clay bordering on white soil and is considered very poor for cultivated crops.

The ground was prepared by plowing in fall and again in spring when it was thoroughly subsoiled. This treatment with thorough harrowing placed the ground in excellent condition for planting.

No manure was applied except in case of varieties 32–33–34, which were fertilized with barnyard manure applied in the hill before planting.

The corn was planted in drills with the hills too close in most cases for best production of grain. No doubt the corn would have matured much better had the hills been planted farther apart and less seed placed in the hill.

For ensilage it is better to drill the corn; but for field corn, in this climate, we believe planting so that the corn can be cultivated both ways would be an advantage. By increasing the advantages of cultivation we hasten the growth and maturity.

More extensive experiments in this line will be carried on during the coming season.

As to the merits of the varieties grown we do not feel warranted in saying much except in a few marked cases. The season was very dry and with the conditions of soil we could expect but meager returns from any of the varieties.

Of the sorts which should be grown for the grain more especially, the flint varieties promise the best results with possibly one exception in No. 28. This variety matured and gave a good yield of stalk and ear. The King Philip type matured in every case and the ears were as dry and round as could be expected in any of the corn growing sections.

Those varieties which promise the best for ensilage giving a large growth of stalk and leaf and a good yield of ears are found in Nos. 29–33–36–37–40–41. While these did not mature quite enough to make the best ensilage, yet with a few more days free from frost, which came unusually early last season, they would have matured completely. In speaking of ensilage corn we would not omit to mention some of the sweet corns. Stowell's Evergreen and Triumph make excellent forage crops and would give a fair yield of excellent fodder for the silo. Some prominent silo advocates, recommend sweet corn in preference to any other for the silo.

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Name of Variety.	No. Plat.	Date of Planting.	Date of Tasseling	Date of Silking	Garden or Field Corn	Remarks.
Asylum	1	Apr 11	July 15	July 29	Garden	Small, Medium early.
Amber Cream	2	"	"	" 25	"	" " "
Crosby's Early Sugar	3	"	" 1	" 1	"	Early, prolific.
Early Minnesota	4	"	"	" 11	"	"
Early Narragansett	5	"	" 18	" 29	"	Early, small.
Excelsior	6	"	" 1	" 23	"	" "
Egyptian Sugar	7	"	" 18	" 29	"	Medium, early.
Hickox's Sugar	8	"	"	"	"	" "
LaCross Early	9	"	Jun 28	" 8	"	Early, small.
Marble Head	10	"	"	" 5	"	" "
More's Concord	11	"	July 8	" 25	"	Medium.
Mammoth	12	"	" 15	" 29	"	Late.
Northern Pedegree	13	"	Jun 28	" 8	"	Small, not desirable.
Ne Plus Ultra	14	"	July 18	" 29	"	Small, medium early.
Perry's Hybrid	15	"	" 1	" 18	"	Medium early.
Potter's Excelsior	16	"	" 11	" 29	"	Small, late
Stowell's Evergreen	17	"	"	" 25	"	Large, prolific, late.
Triumph	18	"	"	" 29	"	Late, desirable.
Golden Yellow	19	"	" 18	" 23	"	Late, small.
Extra Early Cory	20	"	Jun 28	" 8	"	Very early, small.
P. and K. Sugar	21	"	July 1	" 15	"	Medium early.
Black Sugar	22	"	" 11	" 25	"	" "
Extra early Adams	23	"	Jun 28	" 8	Field	Small, fully matured.
Blount's Prolific	24	"	Aug 1	Aug 8	"	Did not mature.
Thorough'ed White Flint	25	"	July 25	"	"	" "
Early Adams	26	"	" 11	July 25	"	Small early sort.
Hickory King	27	"	Aug 8	Aug 15	"	Did not mature.
Queen of North	28	"	July 8	July 18	"	Matured perfectly.
Golden Dent	29	"	" 18	" 29	"	Did not mature.
Queen of Prairie	30	"	" 15	" 25	"	" "
Rider Out or Mercer	31	"	Jun 25	" 1	"	Small, not desirable.
King Phillip	32	" 20	July 11	" 15	"	The best flint.
Chester Co., Mam.	33	"	" 25	Aug 8	"	Did not mature.
Angel of Midnight	34	"	" 11	July 18	"	Not desirable.
Early Yellow Canada	35	"	" 1	"	"	One of best flints.
Golden Beauty	36	"	" 8	Aug 8	"	Did not mature.
True Yellow Leaming	37	" 27	" 29	"	"	" "
Beard's Pearl White Flint	38	"	" 7	" 1	"	" "
Early White Dawn	39	"	" 29	July 29	"	Matured, too small.
White Ensilage	40	" 13	" 15	" 22	"	Good for ensilage.
Yellow Ensilage	41	" 15	" 15	" 15	"	More mature.

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NOTES ON VARIETIES OF POTATOES.

The entire crop of potatoes suffered very much from the extreme dry weather which prevailed throughout the valley. The growth was cut short before full maturity was reached and hence the notes as regards ripening, etc. do not indicate as much as they would if normal conditions prevailed. In one or two cases there was a marked difference in the varieties as regards their power to withstand extreme dry weather. The Duchess continued to grow until killed by frost several weeks after the vines of the other varieties were entirely dead. The Dakota Red, Rural New Yorker No. 2 and Alexander's Prolific maintained a more vigorous growth than their neighbors. The Rural New Yorker No. 2 did especially well and promises to be one of the leading varieties. The old reliable sorts such as Burbank's Seedling, Peerless and Beauty of Hebron, are among those which did the best last season. The California Peach-blow promises to fill the place of the old Peach-blow which was grown so many years with marked success. Further experiment will demonstrate its quality as well as its productiveness.

In growing a large number of varieties under the same conditions we hope to find some which are especially adapted to this climate and soil. To do this it will be necessary to grow them for a series of years selecting those which promise the best results year after year.

The soil on which the potatoes were grown is partly "white land" and received no fertilizing whatever. The seed was planted in drills three feet apart with 3 and 4 eyes in a hill, weeds were kept down and ground kept loose by horse cultivation and hand howing. We aimed to keep the ground level believing that level cultivation is better than hilling or ridging.

During the coming season we expect to carry on the experiment, growing four or five hundred varieties under the same conditions, as nearly as possible, noting the quality, yield, vigor of growth, etc.

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Name of Variety.	No. of Plat	Date of Planting	Date of Harvesting	Date, which Potatoes were Edible	Date, which Potatoes were mature	Remarks.
Alexander's Prolific	1	Apr 9	Sept 25	July 11	Aug 1	White skin very smooth
Alexandria No. 1	2	" 29	"	" 11	" 15	Resembles No. 1
American Giant	3	" 30	"	" 9	" 1	Resembles No. 76
Beauty Hebron	4	" 10	"	June 25	July 9	Flesh color.
Burbank Seedling	5	" 10	"	July 9	Aug 25	Long white.
Big Creek Seedling	6	" 5	"	" 15	July 15	Flesh color.
Burpe's Superior	7	" 30	"	" 11	Aug 26	Seedling of white star.
Charles Downing	8	" 9	"	" 9	" 1	Early prolific.
Clark No. 1	9	" 10	"	" 9	" 1	Very early flesh color.
Crown Jewel	10	" 30	" 26	" 11	July 25	White and smooth.
Collins Serpent	11	" 30	"	" 25	Aug 26	Medium late.
Cal. Peach-blow	12	" 30	"	" 5	" 15	Light color, medium early.
Crane's June Eating	13	" 30	"	" 15	" 1	One of the earliest sorts.
Dakota Red	14	" 9	" 25	" 11	" 15	Flesh color.
Duchess	15	" 30	"	" 25	Sept 10	" "
Early Sunrise	16	" 9	"	June 25	July 9	" "
" Maine	17	" 9	"	"	"	Early, resembles early Rose.
" Rose	18	" 10	" 26	"	"	Rough, not desirable.
" Albino	19	" 10	"	"	"	Clouded with flesh color.
" Puritan	20	" 10	"	"	"	White outside and in.
" Dawn	21	" 29	"	July 11	Aug 1	Early, smooth.
" Essex	22	" 30	"	" 11	"	Smooth, oblong.
" Mayflower	23	" 30	"	" 5	July 25	White, very smooth.
" Ohio	24	" 30	"	" 11	Aug 1	Attacked by rot.
" Rural	25	" 30	"	" 15	" 10	Good early variety.
Extra Early Ohio	26	" 29	"	" 9	" 1	Resembles No. 24
Everett	27	" 30	"	" 15	" 15	Light colored, promising.
Garfield	28	" 10	" 27	June 25	July 9	White and smooth.
Garner Chili	29	" 3	"	July 15	Aug 25	" " "
Grenado	30	" 9	"	June 25	July 9	" " "
Green Mountain	31	" 30	"	July 11	Aug 1	Flesh and skin white.
Gen. Logan	32	" 30	"	" 15	" 15	Large, rather coarse.
Halo of Dakota	33	" 9	" 25	June 25	July 9	Pink in color.
Howe's Premium	34	" 30	"	July 11	Aug 1	Good, medinm early.
Illinois	35	" 30	"	"	"	Resembles E. Ohio.
Imp. Beauty Hebron	36	May 1	"	" 15	Aug 15	Resembles early Rose.
June Eating	37	Apr 9	"	June 25	July 9	White skin smooth.
June's Prize Taker	38	" 29	" 27	July 11	Aug 1	Smooth, desirable.
Jumbo	39	" 30	"	"	"	Large, white, coarse.
Late Beauty Hebron	40	" 10	Oct 3	" 9	" 26	Resembles white elephant.
Lee's Favorite	41	" 29	"	" 11	" 8	White, not uniform.
Lady Finger	42	" 30	"	Aug 1	Sept 5	A novelty.
Morning Star	43	" 9	"	July 9	Aug 8	White, smooth, good keeper.
Monroe Co., Prize	44	" 29	"	" 11	" 1	Very promising.
New Early Standard	45	" 29	"	"	"	Smooth, few eyes, white flesh.
New Queen	46	" 29	" 4	"	"	Good grower, good yielder, smooth.
New Zealand	47	May 1	"	" 15	"	Eyes shallow, smooth.
O. K. Mammoth	48	Apr 10	"	June 30	July 9	Skin smooth, eyes deep.

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Name of Variety.	No. of Plat	Date of Planting	Date of Harvesting	Date, which Potatoes were Edible	Date, which Potatoes were mature	Remarks.
O. K. Mam. Prolific	49	" 29	"	July 11	Aug 1	Skin yellowish, rough, prolific
Pearl of Savoy	50	" 9	Sept 25	June 25	July 9	Tubers oblong, smooth.
Peerless	51	" 10	"	" 30	"	White.
Perfect Peach-blow	52	" 29	" 26	July 11	Aug 1	Irregular in shape.
Potentate	53	" 29	"	"	" 8	Smooth, white, good keeper.
P. E. I. Rose	54	Apr 30	Sept 26	July 11	Aug 8	Medium early.
Polaris	55	" 30	" 28	"	" 1	White and smooth.
Princess	56	" 30	"	" 15	"	Smooth, good yielder.
Rose's New Giant	57	" 9	"	June 25	" 15	White skin and flesh, smooth.
Rural Blush	58	" 9	"	"	"	Flesh colored, rough.
Rural N. York No 2	59	" 9	" 25	July 9	"	White and uniform.
Rose's Beauty of Beauties	60	" 10	" 26	"	July 25	Irregular, eyes deep.
Rural Buttercup	61	" 30	"	" 15	Aug 15	Good new variety.
Salzer's Iron Clad	62	" 9	" 25	June 25	July 9	Late, very white, smooth.
Snow Queen	63	" 9	Oct 3	July 9	Aug 1	Flesh and skin white.
State of Maine	64	" 10	"	"	" 15	" " "
Sunlit Star	65	" 10	"	June 30	July 9	Skin clouded, white flesh.
Seedling No. 64	66	" 30	" 4	July 11	Aug 8	Late, smooth.
Seedling No. 50	67	" 30	"	" 25	" 26	" "
Silver Skin	68	" 30	"	Aug 1	" 8	White, smooth.
Thorburn's late Rose	69	" 9	"	June 25	July 9	Resembles the Rose type.
Thorburn	70	" 10	" 5	" 30	"	Early prolific.
Thunderbolt	71	" 30	"	July 11	Aug 1	Round, smooth, good.
Triumph	72	" 30	"	"	"	Round, smooth.
Tunix	73	" 30	Sept 28	" 15	" 15	" "
Vick's Early Market	74	" 30	"	" 11	" 1	Early, resembles Ohio.
White Star	75	" 9	"	" 9	" 8	White and uniform.
White Elephant	76	" 10	"	" 9	" 26	" streaked with flesh color.
" Seedling	77	" 30	"	" 11	"	White, smooth.
" Lilly	78	" 29	"	" 11	" 1	White, prolific.
W. R. Hull.	79	" 10	"	" 9	"	Coarse, prolific.

NOTES ON VARIETIES OF SORGHUM.

Out of the twenty-four varieties of Sorghum grown last season only a few approached maturity. The most of them failed to produce seed stalks and in many cases only reached two or three feet in height. Nos. 4–5–6–10–12–18–19 matured enough to head out; but did not ripen sufficient for the manufacture of sugar before the canes were killed by frost.

With two or three weeks more of warm weather Sorghum Saccharatum would have fully matured.

Some questions have been asked as regards the use of Sorghum for stock food when cut green or placed in the silo. No experiments have been carried on at this Station but in some of the Eastern States it has received some recommendation as a soiling crop and for filling the silo. So far as the results of last season go corn would be far superior to Sorghum in this climate for the purposes mentioned.

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VARIETIES OF SORGHUM GROWN AT THE STATION.

No. Plat.	Name of Variety.	Where Obtained.
1	Early Amber	Department Agriculture Washington.
2	" Orange Cane	" " "
3	Kaffer's Branching	" " "
4	Sorghum Saccharatum	" " "
5	Early Tennessee	" " "
6	Planter's Friend	" " "
7	Waubausee	" " "
8	Enyama	" " "
9	Swain's Early Golden	" " "
10	Price's New Hybrid	" " "
11	Chinese Sorghum	" " "
12	Whitney's Early	" " "
13	New Sugar Cane	" " "
14	Late Orange	" " "
15	Link's Hybrid	" " "
16	Goose Neck	" " "
17	Kansas Orange	" " "
18	Honduras	" " "
19	White African	" " "
20	New Orange	" " "
21	Improved Orange	" " "
22	Honey Dew	" " "
23	Dutcher's Hybrid	" " "
24	Red Liberian	" " "

NOTES ON ROOT CROPS.

Owing to the extreme dry weather and the depredations of the plant louse (Green Aphis) the root crops were nearly a complete failure except the carrots. This is one very strong point in growing carrots for stock; if properly cared for they are sure to produce more or less excellent food. The habit of rooting deep and growing late in the season enables them to withstand the drought much better than the other root crops.

Of the varieties grown the White Belgian made the largest and most vigorous growth and Long Orange next. The White Belgian did not seem to possess the substance that was shown in the Long Orange. It is more watery and brittle and does not keep so well generally. The Altringham is a smaller variety better adapted for table use.

Of the mangels the Golden Tankard promises the best, being of medium size and much finer in quality than the larger growing sorts. More of the globe varieties will be tested, along with those already grown, during the coming season.

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Lane's Improved Sugar beet proved itself much superior to Vilmorin's in yield and vigor of growth. No doubt it is the best variety to grow for stock food although it is said to contain a less per cent. of sugar than Vilmorin's. The roots were grown on soil that had been thoroughly subsoiled and fertilized with barn yard manure. The seed was sown in drills three feet apart and ground kept free from weeds by cultivating and hand hoeing.

While we do not think it profitable for the average farmer to grow a large acreage of root crops yet we hold to the opinion that no farmer can afford to overlook this most excellent food for young animals and for dairy stock especially.

No. Plat.	Name of Variety.	
1	Carter's Hardy Swedes . . .	Rutabagas
2	Green Globe	"
3	Improved American	"
4	Improved Yellow	"
5	Golden Tankard	Mangel
6	Long Red	"
7	Long Yellow	"
8	Long Red Mammoth	"
9	Long White Tankard	"
10	White Belgian	Carrot
11	Long Orange	"
12	Altringham	"
13	Lane's Improved	Sugar Beet
14	Vilmorin's	"

Mr. H. T. French rendered me valuable assistance in compiling the above notes.

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HORTICULTURAL.

E. R. LAKE.

On the one acre of land at our disposal, in the spring of 1889, for the testing of small fruits and vegetables the following varieties were planted.

SMALL FRUITS. SEE BULLETIN NO. 2.

VEGETABLES.

Bean. Dwarf Horticultural, Golden Wax, Mohawk, *Golden Butter*, * White Wonder, *Advancer*, Dwarf Weiser.

Beet. White French, Eclipse, *Dark Egyptian.*

Cabbage. Early Winningstadt, *Early Wakefield*, *German Drumhead*, *Salzer's Flat Dutch.*

Carrot. Guerande, Yellow Danvers, Danvers, Scarlet Nantes, White Belgian, Yellow Belgian, *Scarlet Horn*, Long Orange.

Cauliflower. Short Stem, Early Paris, *Veitch's Autumn Giant*, *Giant White.*

Celery. Boston Market, *Carter's Ivory*, Giant White, Kalamazoo, *Standard Bearer.*

Corn. Perry's Hybrid, Early Minnesota, Eight Rowed, Cory, Northern Pedigree, Early LaCrosse.

Cucumber. War Club, Siberian.

Lettuce. Satisfaction, Tennis Ball, White Summer, Green Co.'s Prize Head.

Parsnip. *Salzer's White*, Long White, *Long Dutch.*

Pea. McLean's Advancer, Alaska, Carter's Anticipation, Eugenia, Veitch's Perfection, Little Gem, Earliest and Best, New Alaska, Tom Thumb, *Advancer*, Summit, *Champion*, American Wonder, Everbearing, Stratagem, Telephone.

Radish. French Breakfast, White Turnip, Long Scarlet, Chartier, Scarlet Turnip, Peerless.

Tomato. Turner's Hybrid, *Grant*, Cardinal, Carter's Seedless, Trophy, Conqueror, Early Mayflower, Perfect Gem, Acme, Hundred Days, Smooth Red, Paragon, Haines 64, Golden Gage, Yellow Plum.

Turnip. *Stone*, Green Globe, *Jersey Lily*, White Egg.

*The italicized names are corrections made in accordance with Circular No. 11, office of Experiment Stations, U. S. Department of Agriculture. The changes have been made after consulting the committee in charge of such work, for the Association of Experiment Stations.

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GENERAL COMPARATIVE NOTES.

Owing to the extremely dry summer and to the fact that our land was in very poor condition in consequence of much teaming having been done on it during the previous winter, we are unable to make many valuable notes even comparative ones. Many of the different varieties were necessarily planted under very unequal conditions and accordingly fair comparisons can be made with only a few.

Beans. Seven varieties.—These were under such unequal conditions regarding time of planting, and soil fertility that the notes taken this year will only serve to assist in next year's work.

Beets. Three varieties.—White French made very meagre growth. It started well but the drouth seriously interfered with its after growth. The quality was very poor, even while young. Eclipse and Dark Egyptian made good growth and gave a crop of very smooth, tender and excellently flavored roots.

Cabbage. Five varieties.—The four giving best results were, German Drumhead and Flat Dutch for size and lateness; Early Wakefield and Early Winningstadt for earliness and quality. While for quality in their respective classes, of early and late, we found Early Wakfield and German Drumhead the best.

Carrots. Ten varieties.—The following five head the list in the order given: Guerande, White Belgian, Danvers, Yellow Belgian, Long Orange. The remaining five ranked much below these and were about equal except, Scarlet Nantes which was of good quality although a poor yielder. For ten feet of row (rows 18 inches apart), the first five gave the following weights of roots: 34 lbs., 28 lbs., 26 lbs., 25 lbs., 23 lbs.

Cauliflower. The seed of several varieties was sown but for various reasons only one variety reached maturity, Veitch's Autumn Giant. The seed of this was sown in the open air on April 24th. When transplanted, July 15th, the plants were fertilized in the hill with night soil compost. They began to be of marketable size Oct. 28th, and the last heads were taken Dec. 20th. Average weight of heads 1½ pounds: heads very close and of good form.

Celery. Five varieties.—Giant White, made a clean average growth of 16 inches, and was of fair quality. Boston market, made an average growth of 14 inches, and was of poor quality. Carter's Ivory was seriously affected with the rot (probably due to too early earthing up.) A small portion left and earthed up later than the general crop made a fair growth but was of poor quality. Standard Bearer was about the same as Boston Market. Kalamazoo made shorter growth than the others, 11 inches, but was solid, of excellent quality and free from rot and rust.

Cucumber. War Club; seed presented by Northrup, Braslan & Co. The seed of this variety was sown in pots April 2nd; planted in cold frame May 3rd; first fruit taken July 19th; length of fruit 14 inches; diameter 3 inches, this being the average size all the season.

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Some plants set in the open ground June 6th, grew very rapidly and to great size. The amount of fruit taken off was remarkable; the average length was 12 inches. It was of excellent flavor, being free from all bitterness.

The Siberian was not recorded.

Lettuce.—Was overtaken by drouth and no record made.

Peas. Fourteen varieties.—The following gave the most satisfactory results. Carter's Anticipation, most productive and third in earliness.

Summitt, earliest and third in productiveness; first picking for market ninety-one days from sowing.

Earliest and Best, second in earliness and second in productiveness.

Stratagem and Telephone ranked about the same. Stratagem made a little the stronger growth, while Telephone was the better flavored.

Radish. Six varieties.—Only one of any value in the test. Chartier made excellent growth; was very crisp and tender.

Tomato. Fifteen varieties.—Turner's Hybrid, Cardinal and Carter's Seedless ranked the highest, and in the order of their enumeration. Turner's Hybrid was the only one of the larger varieties that was practically free from rot. Cardinal was injured at least 25 per cent.; Carter's Seedless, 15 per cent.; Trophy, 35 per cent. and the others averaged about the same loss from this disease; while Golden Gage and Yellow Pear, two small ones, were uninjured.

Turnip. A record of only three varieties was kept. The yield on 100 sq. ft. was as follows: Green Globe, 36 lbs.; White Egg, 78 lbs.; Jersey Lily, 53 lbs. These were grown on land well enriched with stable manure and night soil compost.

On land enriched only with stable manure, Green Globe for the same space gave only 30 lbs.

ORCHARD FRUITS. SEE BULLETIN NO. 2.

This list as also the list of small fruits, will be very largely increased by the proposed plantings this spring.

ORNAMENTALS.

Deciduous Trees. The following ornamental trees, shrubs, vines and climbers are now on the grounds. Most of them are small (from 6 to 20 inches high) and will receive nursery culture for a few years:

Acer campestre, European cork maple.
" dasycarpum, Silver maple.
" platanoides, Norway maple.
" pseudo-platanus, European sycamore maple.
" rubrum, Red maple.
" saccharinum, Sugar maple.
" macrophyllum, Oregon maple.

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Acacia julibrissin, Mimosa tree.
Æsculus glabra, American horse chestnut.
" hippocastanum, European horse chestnut.
Ailanthus glandulosa, Tree of Heaven.
Alnus glutinosa, European alder.
" Oregana, Oregon alder.
Amelanchier alnifolia, Serviceberry.
Amygdalus sp. ?, Flowering almond.
Andromeda arborea, Sorrel tree.
Asimina triloba, Pawpaw.
Betula alba, European white birch.
" rubra, Red birch.
Carpinus Americana, Hornbeam.
Carya alba, Shellbark hickory.
" olivæformis, Pecan nut.
" sulcata, Large fruited hickory.
Castanea Americana, American chestnut.
" vesca, Spanish chestnut.
Catalpa bignonioides, Catalpa.
" speciosa, Western catalpa.
" Kæmpferi, Japan catalpa.
Celtis occidentalis, Nettle tree.
Cercis Canadensis, American Judas tree or Red bud.
Cladrastis tinctoria, Yellow wood.
Cornus florida, Dogwood.
" Nuttallii, Dogwood.
Diospyros Virginiana, American persimmon.
Fagus Americana, American beech.
Fraxinus Americana, White ash.
" sambucifolia, Black ash
" viridis, Green ash.
" Oregana, Oregon ash.
Gleditschia triacanthos, Honey locust.
Gymnocladus Canadensis, Coffee tree.
Koelreuteria paniculata.
Laburnum vulgare, Common laburnum.
Larix Europæa, European larch.
Lindera Benzoin, Spice wood.
Liquidamber styraciflua, Sweet gum.
Liriodendron tulipifera, Tulip tree.
Maclura aurantiaca, Osage orange or Bow wood.
Magnolia acuminata, Cucumber tree.
" macrophylla.
Morus rubra, Mulberry.
Negundo aceroides, Box elder.

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Nyssa multiflora, Sour gum.
Populus balsamifera, Balsam poplar.
" monilifera var. Van Geertii, Golden poplar.
Prunus emarginata var. mollis, Oregon wild cherry.
Ptelia trifoliata, Hop tree.
Pyrus aucuparia, European mountain ash.
" " var. spectabilis.
" rivularis, Oregon crab apple.
Quercus prinus, Chestnut oak.
" macrocarpa, Burr oak.
" tinctoria, Black oak.
" Garryana
Robinia psued-acacia, Yellow locust.
Gingko adiantifolia, Gingko.
Sassafras officinale, Sassafras.
Staphylea colchica, Asiatic bladder nut.
" trifolia. American " "
Taxodium distichum, Bald cypress.
Tilia Americana, American basswood.
" vulgaris, European basswood.
Ulmus Americana, American elm.
" fulva, Slippery elm.
" campestris, English elm.
" racemosa, American cork elm.

Deciduous Shrubs.

Callicarpa purpurea.
Calycanthus floridus, Sweet shrub.
Caragana aborescens, Siberian pea.
Cephalanthus occidentalis, Dwarf buttonwood.
Chionanthus Virginica, White fringe.
Colutea arborescens, Bladder Senna.
Cornus Mas, Cornelian cherry.
" sanguinea, English Dogwood.
Cotoneaster floribunda.
" obtusa.
" Wheeleri.
Cratægus rivularis, Hawthorn.
Deutzia crenata.
" fortuni.
" scabra.
" gracilis.
Diervilla trifida.
Dirca palustris, Leatherwood.

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Eleagnus parvifolius, Silver thorn.
Euonymus atropurpureus, Burning bush.
Forsythia suspensa, Golden bell.
" viridissima.
Genista scoparius, Scotch broom.
Halesia tetraptera, Snowdrop shrub.
Hibiscus syriacus—varieties—Rose of Sharon.
Hydrangea paniculata grandiflora, Hydrangea
Hypericum patulum.
Ilex monticola, Deciduous holly.
" verticillata.
Itea Virginica.
Ligustrum vulgare—Privet.
Lonicera fragrantissima, Bush honeysuckle.
" tatarica grandiflora, Tartarian honeysuckle
Myrica Californica, Candleberry myrtle.
Philadelphus coronarius, Mock orange.
" grandiflorus.
" Lewisii.
Ribes sanguineum.
Rosa Carolina.
" lucida.
Spiræa Billardi.
" Hookeri.
" paniculata.
" callosa.
" prunifolia.
" Reevesii.
" Thunbergii.
Syringa rubra insignis, Lilac.
" vulgaris alba.
" Josikæa.
" Persica.
Viburnum opulus.
Weigela rosea.
" Descoisii.
" floribunda.
" candida.
" hortensis nivea.

Evergreens.

Abies excelsa, Norway spruce.
" grandis, White fir.
" nobilis, Red fir.
" pectinata.

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Arctostaphylos tomentosa, Bearberry.
" Uvi ursi.
Buxus sempervirens, Box (Dwarf).
Berberis aquifolium, Oregon Grape.
Chamæcyparis Lawsoniana, Lawson's cypress.
Cupressus macrocarpa, Monterey cypress.
Euonymus Japonicus, Spindle tree.
Ilex opaca, American holly.
Juniperus communis Hibernica, Irish juniper.
Picea pectinata.
Pinus Austriaca, Austrian pine.
" contorta, Scrub pine.
" ponderosa, Bull pine.
" strobus, White pine.
" sylvestris, Scotch pine.
Rhododendron Californicum.
Rhetinispora filifera, Japan cypress.
" pisifera.
" plumosa.
" squarrosa.
Taxus brevifolia, Yew.
Thuya gigantea, Arbor-vitæ.
" occidentalis aurea.
" " globosa.
" " Meehani.
" " ericoides.
" orientalis.

Vines and Climbers.

Ampelopsis Veitchii, Japan ivy.
Aristolochia sipho, Dutchman's pipe.
Bignonia grandiflora, Chinese trumpet vine.
" Thunbergii.
Clematis Jackmani, Virgin's bower.
Dolichos Japonicus.
Euonymus radicans, Climbing euonymus.
Hedera Helix, English ivy.
Jasminum nudiflorum, Yellow jasmine.
Lonicera flava, Honeysuckle.
" fuchsioides.
" Halleana.
" sempervirens.
" brachypoda.
Menispermum Canadense, Moonseed.
Wistaria frutescens, Glycine.

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Wistaria magnifica.
" sinensis.
" " alba.
" multijuga.

HOUSE PLANTS.

The following list in limited variety is to be found in the greenhouse:

Acacia, Adiantum, Aloe, Asplenium, Azalia, Begonia, Cereus, Calceolaria, Camellia Centaurea, Chamærops, Cheilanthes, Cineraria, Codiæum, Coleus, Cyclamen, Dianthus, Euphorbia, Echinocactus, Fuchsia, Geranium, Gloxinia, Iresine, Opuntia, Pelargonium, Pellæa, Phœnix, Primula, Pteris, Selaginella, Verbena, Chrysanthemum,

PROPOSED PLANTINGS OF SMALL FRUITS, 1890.

Currant, Fay.

Gooseberry, Industry, American.

Grape, August Giant, Nectar, Oneida, Gaertner, Moore's, Diamond, Woodruff Red, Worden, Pocklington, Ulster Prolific, Mayer, Herbert, Hartford, Early Victor. Agawam, Peabody, Purity, Wilding, Requa, Jewel, Golden Gem, Delaware, Faith, Concord Muscat, Peerless, Gilt Edge, Improved Delaware, Witt.

Blackberry, Eri, Agawam, Snyder, Taylor.

Raspberry. Thompson's Early Prolific, Gregg, Souhegan, Shaeffer's Colossal, Crimson Beauty. Mendocino.

Strawberry, Michel's Early.

PROPOSED PLANTINGS OF ORCHARD FRUITS.

Apples. Alexander, Twenty Ounce, Gravenstein, Pewaukee, Chenango, Fall, Queen, Fall Jenneting, Oldenburg, Western Beauty, Pumpkin Sweet, Red Beitigheimer? Kinkead? Keswick Codlin, Sops of Wine, Summer Queen, Edgar Red Streak, Ontario? Westfield, Ben Davis, Baldwin, Mann, Late Strawberry, Shiawassee Wolf River, Longfield? Green Sweet, Ewalt, N. W. Greening? White Pippin, Rawle's Genet, Winter Sweet Paradise, Ohio Pippin, Gideon, Scott's Winter? Tompkin's King, Hubbardston, Limber Twig, McAfee Bailey Sweet, Arnold's Beauty, Stump? Fall Pippin, Kentucky Red, Munson Sweet, Saint Lawrence, Yellow Transparent, Colvert, Autumn Swaar, Flory? Stark, Trumbull Sweet? Golden Sweet, Canada Sweet? Early Strawberry, Red Astrachan, Holland Pippin, Benoni, Early Harvest, Wealthy, Summer Seek-no-Further, Bottle Greening? Northern Spy, Rambo, Grimes' Golden, Fallawater, Hyde's King of the West? Winesap, Wagener, Lawyer? Ribston Peter? McIntosh Red, Delaware Red? Salome? Golden Russet, Talman Sweet, Rhode Island Greening, Fameuse, Roxbury Russet, Dominie, Rome Beauty, Gano, Dutch Mignonne, Whitney's No. 20? Abram? Bethlemite, Buckingham, Belmont, Capp's Mammoth? Celestia? Charlottenthaler? Early Colton? Fall Wine, Hewe's Crab, Jonathan, Jewett's Red, Little Romanite? Lady's

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Sweet, Lady, May-of-Myers ? Missouri Pippin, McMahan's White, Nelson's Sweet ? Melon, Ortley, Rock Pippin, Red Canada, Standard ? Wythe, York Imperial, Loy ?

Crab Apples. Montreal Beauty, Yellow Siberian, Martha ? Transcendent, Hyslop, Van Wyck's Sweet ? General Grant ?

Nectarines. New White ? Boston, Clements ?

Peaches, (*Freestone*) Alexander, Hale's Early, Ulatis ? S. G. French ? Miss Lola ? Pansy Pabor ? Yellow St. John, Amelia, Bishop's Early ? Pallas ? Berenice ? Gov. Briggs ? Foster, Oriole ? Crawford's Early, Mary's Choice ? Honest Abe ? Reeves' Favorite, Muir ? Susquehanna, Newhall ? Wheatland, Globe Ellison ? Lemon, Elberta, Columbia, Scruggs ? Picquett's Late, Lovell ? Comet ? Salway, Marshall's Late ? Leopard ? Chair's Choice ? Wonderful ? October ? Baldwin's Late ? Bilyeu's.

(*Clingstone*) McKevitt ? Tuscan ? Alpha ? Roseville ? Seller's ? Nichol's Orange ? Grover Cleveland ? Mother Porter ? Hardy Tuscany ? Indian Blood Cling, Austin's Late.

Pears. Bartlett, LeConte, Flemish Beauty, Duchesse ? Anjou, Comet ? Lawrence, Goodale, Swan's Orange ? Lucrative, Boussock, Frederick Clapp, Madeleine, Summer Doyenne, Louise Bonne of Jersey, Bordeaux, Bosc, Vicar, Kieffer, Clapp's Favorite, Sheldon, Seckel, Howell, Clairgeau, Buffum, Mount Vernon, Osband's Summer, Bloodgood, Tyson, Brandywine, Easter Beurre, Dana's Hovey, Souvenir du Congress, Margaret, Dearborn, Seedless ? Chenilla ? Angouleme, Grand Isle ? Garber ? Hosenschenk, Josephine of Malines, Longworth No. 1 ? Little Gem ? Peffo's No. 1 ? President ? Refreshing, Cole's Seedless.

Persimmon. Goshio Maru, Lemon, Haihija, Kuro Kume, Hyakume.

Plums. Washington, Yellow Magnum Bonum ? Italian Prune, Jefferson, Bavay, McLaughlin, Genii ? Lombard, Garfield ? Ogon ? Pottawattamie ? Wolf, Mariana, Bradshaw ? Shropshire Damson, Spaulding ? Imperial Gage, Duane's Purple, Shipper's Pride ? General Hand, Niagara ? Smith's Orleans, Botan ? Prunus Simoni ? Wild Goose, Weaver, Kelsey's Japan ? De Soto, Satsuma ? Burbank ? Richland, Yellow Gage ? Yellow freestone ? (Japan, from Burbank), Caddo Chief ? Coe's Golden Drop, Golden Beauty ? Hungarian ? Maquoketa ? Russian No 1 ? Victoria.

NUT TREES.—ALMONDS.

I. X. L., Nonpariel, Ne Plus Ultra, Llewelling's Prolific, Drake's Commercial, Wolfskill, Sultana, Golden State, Routier's Twin.

WALNUTS.

Sieboldi, Nos. 3, 4, 5 and 6 New Japan, (Burbank.)

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DEPARTMENT OF CHEMISTRY.

P. HERBERT IRISH, Chemist. W. D. BIGELOW, Assistant.

The following work in this department has been carried on—

Examination of a Clay sent to the station by Mr. Mahone, of Alsea, who desired to know whether it was suitable for a fire clay. As we did not possess the apparatus necessary for making a physical analysis of the sample, it was impossible to determine accurately the amount of clay contained. The substance was chemically analyzed with the following results:

Volatile matter	.77
Iron and Alumnium oxide	14.30
Carbonic acid	5.51
Manganic oxide	2.56
Titanic acid	3.94
Silicic acid	13.76
Magnesium oxide	.52
Sand	57.09
Alkalies and loss	1.55
	100.00

The silicic acid given is that obtained by decomposing the clay with sulphuric acid and extracting the silicic acid set free with soda solution. The amount left insoluble in soda was not further analyzed but was reckoned as sand. A further test was made in the following manner: A small amount of the clay was rolled out, and cut up into bars about 3-32 of an inch wide and thick, and 2½ inches long. One of these was after drying at 140 degrees C., supported at either end by platinum wires, and placed in a gas combustion furnace and brought to about the temperature of white hot iron. After allowing it to cool the piece was examined and was found to have been apparently unaffected by the high temperature; showed no marks of usion and had not become bent. The baked clay was not as hard and strong as might be desired for a fire clay, but otherwise, it would seem from all of the tests which we were able to give it, adapted for the purpose.

Analysis of a Rock sent to the station by Mr. Perkins, of Llewellyn, who desired to know whether it was a natural cement rock. A small quantity of the same was kept at a red heat for some time and the residue thus obtained after being allowed to cool, was moistened with water. No heat was generated and the mass when allowed to dry showed none of the properties of cement. The following is the per centage composition of the rock:

Manganese oxide	2.22 pr. ct.
Silicic acid	34.24 "
Carbonic acid	23.27 "
Iron oxide	3.58 "
Alumnium oxide	6.56 "

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Magnesium oxide	12.35 pr.ct.
Calcium oxide	12.28 "
Volatile matters	4.88 "
	99.38 "

The examination would seem to show that the rock is not fitted for the purpose for which it is desired.

MINERAL WATER ANALYSIS.

The sample of mineral water, the result of the examination of which is given below, was sent by Mr. Dunham Wright of Medical Springs, Union Co. The spring is a warm one, the water issuing from the earth boiling hot. The method of analysis used was in the main, the one given by Bunsen. (Bunsen Mineral Wasser Analysis.) The principal departure from this scheme being in the separation of the alkalies, where the methods of separating the sulphuric acid as lead sulphate, the earths with ammonia, the alkaline earths as the oxalates and magnesia by precipitation with red oxide of mercury, were made use of. The method of calculating results was that given by Bunsen. The summation of the work is given in parts in one hundred thousand.

Total solids pts. per. 100,000	89.52
Calcium chloride	5.512
Magnesium chloride	.466
Potassium chloride	.642
Sodium chloride	5.758
Sodium sulphite	.524
Sodium sulphate	50.638
Sodium carbonate	.579
Iron sulphate	.558
Calcium sulphate	12.175
Calcium carbonate	1.417
Silicic acid	9.698
Organic matter, etc.	1.553
	89.52

WHEAT ANALYSIS.

The analysis given below are to be taken as the beginning of operations, having for their end, observations with regard to the effect of climate and soil upon the composition of wheat. Oregon, presenting in its different sections, widely differing conditions of climate and soil presents an exceptionally good chance for such work. Of course no results of importance can be reached without a study of the problem through many consecutive years. Hence without any attempt to draw conclusions where sufficient data is not present, we submit the analysis given below as a result of progress.

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Before going into the details of the analysis it may be well to explain the terms made use of.

There are in wheat a series of substances containing nitrogen, among which we have the components of gluten, etc. These substances are classed under the general head of albumenoids. It is to their presence in the grain, that to a large extent is due the flesh forming value of the cereal. We find also a quantity of soluble nitrogenous compounds which are also valuable food constituents. The quantity of nitrogen then becomes, as it were, a measure for the food value of the grains. Thus we may consider one rich in nitrogenous material, more valuable, other things being equal, than one poor in these compounds. Corresponding to the two classes of compounds mentioned above, will be noticed in the tables, the percentages of albumenoids, and of soluble nitrogen. With regard to the calculation of the amount of albumenoids it may be well to state that the factor 6.25 was made use of, on account of it being generally the custom of American Chemists to use this number in calculation from the amount of albumenoid nitrogen, although the use of a lower number would be more correct since according to Ritthausen (Y. Ber. Chem. 1864, 625-7, 1863, 618.) Vegetable Fibrin, Gluten Casein, Mucedine and Gliadine, of which consist the greater part of the wheat albumenoids, contain more than sixteen per cent. of nitrogen.

By Ash is meant those inorganic substances found in the grain such as lime, potash, etc. From a consideration of an ash analysis we may obtain a calculation of the amount of the valuable fertilizing salts removed from a farm, in the grain sold.

Crude Fibre is the woody portion of the grain kernel.

The starch gum, etc., may be calculated by difference.

It may now be well to state the source of the different wheats :

No. 10 "New York Spring," was grown on the station farm from seed procured in New York state.

No. 16, is the seed from which No. 10 grew.

No. 11, is the Fosia a wheat which has been grown in Oregon, Prof. Grimm states, twenty-five years. The sample analyzed was grown on the station farm.

No. 13, is a Bordeaux wheat grown on the station farm from seed imported from France.

No. 19, is the French Imperial grown from No. 14.

No. 17, is the White Russian imported.

No. 18, is the White Russian grown from No. 17 on the Experiment Station farm.

Nos. 20, 21 and 22 are analysis of samples of Club, Blue Stem and Red Chaff wheats, sent by Pierce, Long and Elam, of Milton, Oregon.

Nos. 23, 24 and 25 are analysis of samples sent us by Mr. Clark Walter of Athena, Oregon. All grown near Athena. They are Blue Stem, Club and Red Chaff.

With regard to the history of these Mr. Walter's says :

The blue stem was brought to Oregon from Australia, in 1882. The Red Chaff was introduced at the same time.

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WHEAT ANALYSIS, CALCULATED TO AIR DRIED SUBSTANCE.

Name, date and place of growth.	Total Nitrogen.	Sol. Nit'n.	Fat.	Crude Ash.	Water.	Crude Fibre.	Anal's No.
New York Spring . . College Farm, 1889 .	2.21	.28	2.65	2.67	11.28	3.45	10.
New York, Spring . . New York State, 1888.	1.93	—	2.27	—	12.76	5.26	16.
Fosia . . . . . College Farm, 1889 .	1.70	.20	2.77	2.26	12.25	3.11	11.
Bordeaux . . . . . College Farm, 1889 .	1.93	.20	2.13	2.3	12.30	3.97	13.
French, Imperial . . France, 1888	1.92	—	2.43	2.04	12.56	3.75	.14
French, Imperial . . College Farm, 1889 .	1.35	.22	2.11	2.14	12.69	3.57	19.
White Russian . . Imported, 1888 . . .	2.04	.20	1.95	—	12.82	—	17.
White Russian . . . College Farm, 1889 .	1.60	.27	2.14	2.78	13.17	4.42	18.
Club . . . . . Milton, Oregon, 1889	1.26	.19	2.16	2.55	10.89	4.63	20.
Blue Stem . . . . . Milton, Oregon, 1889	1.29	.21	1.86	2.43	11.19	4.21	21.
Red Chaff . . . . . Milton, Oregon, 1889	1.76	—	2.03	2.76	10.20	4.32	22.
Blue Stem . . . . . Athena, Oregon, 1888	1.89	.28	2.58	2.21	12.92	3.48	23.
Club . . . . . Athena, Oregon, 1889	1.65	.17	2.11	2.83	10.94	3.47	24.
Red Chaff . . . . . Athena, Oregon, 1889	1.42	.16	1.78	2.73	12.70	5.07	25.

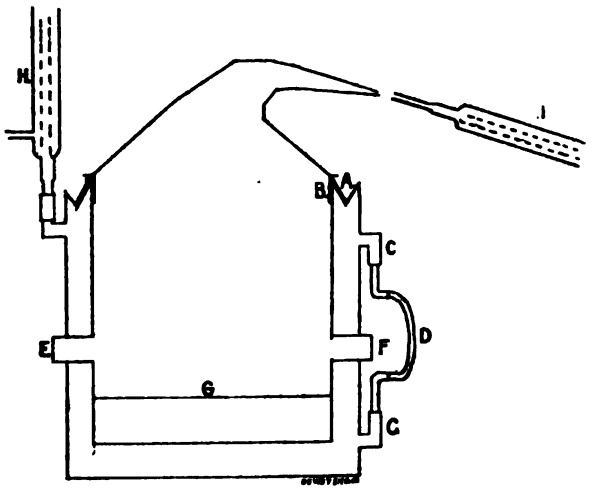
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WHEAT ANALYSIS CALCULATED TO SUBSTANCE DRIED AT 100°C

Name, date and place of growth.	Total Nitrogen.	Soluble Nit'n.	Albu'n oids.	Crude Fibre.	Fat.	Crude Ash.	Anal's No.
New York, Spring College Farm, 1889	2.49	.31	13.63	3.89	3.00	3.01	.10
New York, Spring New York State, 1888	2.21	—	——	6.03	2.60	——	.16
Fosia College Farm, 1889	1.94	.23	10.69	3.54	3.16	2,58	.11
Bordeaux College Farm, 1889	2.20	.23	12.31	4.53	2.43	2.62	.13
French Imperial France, 1888	2.20	—	——	4.29	2.78	2.33	.14
French Imperial, College Farm, 1889	1.55	.25	8.13	4.09	2.42	2.45	.19
White Russian, Imported, 1888	2.34	.23	13.19	—	2.24	—	.17
White Russian, College Farm, 1889	1.84	.31	9.56	5.09	2.46	3.20	.18
Club, Milton, Oregon, 1889	1.41	.21	7.50	5.20	2.42	2.86	.20
Blue Stem, Milton, Oregon, 1889	1.45	.24	7.56	4.74	2.09	2.73	.21
Red Chaff Milton, Oregon, 1889	1.96	—	——	4.81	2.26	3.07	.22
Blue Stem Athena, Oregon, 1888	2.17	.32	11.56	4.00	2.96	2.54	.23
Club Athena, Oregon, 1889	1.85	.19	10.38	3.90	2.40	3.20	.24
Red Chaff Athena, Oregon, 1889	1.63	.18	9.06	5.81	2.04	3.13	.25

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AN APPARATUS FOR USE IN THE DETERMINATION OF FAT IN PLANT SUBSTANCES.



The following apparatus which is made use of in the Corvallis laboratory may be of some interest to agricultural chemists, as giving a simple way of distilling off the ether, from the fat extract, and drying and cooling the fat in an atmosphere of hydrogen. It consists of a double walled copper vessel, with a retort shaped cover. The latter being held in place by a comparatively tight fitting joint B, on the inside, and made hydrogen tight by a luteing of fire clay, placed over and around a flange A, which fits down into a depression made in the double wall. A tube F, passes through the wall for the admission of dried hydrogen; another E, on the opposite side passes out to allow the hydrogen to escape. These tubes are so arranged, as to allow of their being stopped tightly with a cork.

The space between the double walls which is to be filled with water, has a peculiar shaped water guage C, D, C, and is connected with a reflux cooler H. The retort head is connected with a condenser I, six feet in length, which delivers the ether distilled off, in a can whose mouth is partially stopped with cotton to prevent danger from fire. The inside of the double walled vessel is about 23 centimeters diameter, 20 centimeters high, contains a false bottom G, with holes of the proper size to hold the flasks containing the extract, and can receive seven fat determinations at one time. The method of using is as follows: A light glass flask of about 100 C. C. capacity, fitted with a Pt. wire for suspending on the balance, is accurately weighed, into this the ether to be used for extraction is brought, and the flask connected with a fat extractor, made after the design of Professor Tollens. After the extraction has been completed, the flasks containing the extracted fat are brought into the double walled

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vessel, the cover is luted on the lamp below the apparatus lighted, connection made with the condensed I, and the temperature of the apparatus gradually raised to that of boiling water. By this means, all of the ether which was contained in the flasks is gasified. When the water has been boiling some little time, in order that all of the ether, may be collected, the cork which up to this time had closed the aperture F, in the side of the vessel is removed replaced with a perforated cork connected with a hydrogen apparatus furnishing dry hydrogen. The gas is run in until no more ether is seen to drop from the cooler. The connection between the cooler I and the drying vessel is then broken, the opening of the retort stopped with a cork, and hydrogen gas allowed to pass into the vessel for about three hours, the temperature being meantime maintained at the temperature of boiling water and the hydrogen being burned, or allowed to escape through a glass tube, placed in a perforated cork which stops the opening E. When the drying process has been carried on for about three hours, by removing the rubber tube D, from the water guage, connecting the lower side of the guage with the water supply, and the upper with waste pipe. It is possible to quickly cool the fat in a hydrogen atmosphere The flasks are then immediately weighed. The apparatus can be made by any good tinsmith, from tinner's copper.

MINERAL WATERS.

Owing to the large amount of labor necessary in carrying out a quantitative analysis of a mineral water, and the very limited working force of the chemical department, no further *quantitative* determinations of such waters, can be undertaken. A qualitative determination will however be made, and enough work done to determine whether the water sent is worthy of more careful investigation.

The following directions must be followed in taking the water samples.

Obtain a bottle or bottles capable of containing one gallon. Clean perfectly. Rinse out with the water of the spring. Then holding the bottle bottom side up, sink it carefully in the water. When the mouth of the bottle is about one foot below the surface of the spring, allow it to fill, being careful not to obtain any sediment with the water. When full quickly cork the bottles with *new* corks, which have been previously washed with the spring water. Drive the cork well in, cut off even with the neck of the bottle, seal with sealing wax and send *prepaid* by express to the Experiment Station. Send at the same time by mail, express receipt also a letter stating the following particulars with regard to the spring. Temperature of the water, (obtained by allowing a thermometer to remain in the spring for five minutes and then reading) whether any gas bubbles are noticed coming to the surface. Whether there is any peculiar smell noticed coming from the water. If any deposit from the water is noticed, send a sample in a wide mouthed bottle, or tightly closed fruit jar. State how much water flows per minute. In all cases before sending water, write to find out when to send, as it is necessary to have the water sent, only a few days before the examination is made. Address all communications on the subject to the Chemist of the Station.

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SOIL ANALYSIS.

A chemical examination will, unless accompanied by experiments in tilling of a soil be of little use. Hence we cannot make such analysis, unless those sending the soils are willing to carry out carefully conducted experiments, on their land, under our direction. In which cases a few examinations can be made. There should always, however, before anything further is done, be a communication addressed to the Chemist of the Station, describing the general character of the land, in order to learn at what time the work can be undertaken.

The following directions, must be carefully followed, in sampling the soil:

A box one foot high, long, and wide, is to be constructed of inch boards, well fastened together. This is to be placed with the open side downwards, upon the soil to be sampled. Then with a sharp shovel or spade, the earth is to be cut away so as to allow the box to sink over a column of the soil. When the box has, in this way been completely filled, the base of the column is to be cut with the spade, the box turned right side up, a tight cover nailed on, and sent by express, *prepaid*, to the Experiment Station. An express receipt for the package should at the same time be mailed to the Chemist of the Station.

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OREGON

Agricultural Experiment STATION.

BULLETIN NO. 5.

ENTOMOLOGY.

I.—Introductory.

II.—Some Injurious Insects and Remedies therefor.

III.—Experiments with Grain Beetle.

ZOOLOGY.

IV.—Gophers and Rabbits.

CHEMISTRY.

V.—Fertilizers.

APRIL, 1890.

The Bulletins of this Station are sent free to all residents of the State who request them.

SCHWAB BROS. PRINTING AND LITHO. CO., PORTLAND.
1890.

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ENTOMOLOGY.

F. L. WASHBURN.

INTRODUCTORY.

IT is estimated that insects annually destroy over $300,000,000 worth of crops in the United States. Hence the importance of acquainting oneself with the best means of exterminating them, or, at least, lessening the injuries caused by them, cannot be over-estimated.

Less than ten years ago Oregon was comparatively free from injurious insects, but, as we now see, immunity from insect pests cannot always be expected, and the large numbers of the Codling Moth, Peach Borer, Woolly Aphis and other insects present here to-day, are only precursors of more destructive pests which will, almost inevitably, reach us. It is a well authenticated and depressing fact that insects always thrive better in a new home than in the old. Many reports of injuries by the following insects came from different parts of this state and remedies are asked for:

Codling Moth, Woolly Aphis, Green Aphis, Pear Slug, Peach-tree Borer, San Jose Scale, Flat headed Apple tree Borer, Gooseberry Fruit Worm, Currant Borer, Flea Beetle, Pea Weevil, Strawberry crown Borer, Cut Worms and Grain Beetle.

It is in compliance with this demand that the following articles are published, being, necessarily, largely compiled from work done by the government elsewhere and in part the result of work of officers of this Station.

The article on the Grain Beetle (Silvanus surinamensis) contains the results of some observations and experiments at the Station during the past three months, the beginning of a series of experiments to determine some inexpensive and effective means of ridding granaries of this pest.

The article on Gophers and Rabbits is the result of some observations here during the fall and winter just passed, supplemented by the experience of many others in this State, in California and in the East. Many letters reporting injuries by these animals, and asking urgently for remedies, called for a special effort in that direction.

It is the plan to make the Station publications on Entomology, appearing from time to time, a continuous treatise on insects injurious to farm and orchard, on their habits and life histories, and the best means of exterminating them. With this end in view, we suggest that farmers of the State preserve these publications for future reference.

It is confidentially hoped and expected that all active workers will not hesitate to communicate their experiences in combatting insect pests, for it is by such co-operation with the Station force that the best results are obtained.

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In the following pages references are made to Bulletin No. 3, issued in October, 1889. That Bulletin was largely taken up with descriptions of spraying machines and cost of same, and with a discussion of insecticides and their uses.

Past Bulletins can be had on application.

Acknowledgements are due Prof. C. V. Riley, of Washington, Mr. B. M. Lelong, of the California State Board of Horticulture, Profs. Wickson, of California and Lugger of Minnesota, for courtesies extended.

THE CODLING MOTH.

So much has been said in Bulletins, through the press, and by lectures, of the habits of this pest, that we will content ourselves here with saying that this moth, producing the apple worm, is about ½ in. long with waving transverse lines of gray and brown on the fore wings and a round tawny spot near the hind border, marked with bronze streaks. The hind wings are brown. It flies entirely at night or in the evening dusk, and is rarely seen; hence the few words of description given above.

REMEDIES.

1. **Spraying.** The first spraying should be done one day after all the bloom has fallen, while the apples are still standing and no larger than peas. Paris Green has given the best results so far, and until we are convinced of a better poison we shall use this. One pound of Paris Green to two hundred gallons of water is the right proportions for this part of the country. Should this burn the foliage, which is not likely, more water should be added. For accounts of the machinery for spraying fruit trees, and suggestions regarding handling of the poison, see Bulletin No. 3, from this station.

As to the number of sprayings to be applied this can be said; if all the orchadists in one locality would unite in the first spraying, and do that thoroughly, that would so effectually kill off the first brood of catterpillars, that subsequent injury would be little or nothing. This would mean, however, most thorough work, in which every man, though owner of only a few trees, should faithfully do his share.

Unfortunately in almost every locality there are some who will not co-operate. They thus allow their orchards to become a breeding place for the moth, and force their neighbors to a continual warfare with this pest.

This being the case, and until the matter is put upon a better basis, we advocate a number of sprayings, as many as seven or eight in this country, where the warm season is so long and the moth so many brooded. We are convinced that before long when the matter is more thoroughly understood and the necessity for concerted action realized, that fewer sprayings will accomplish all that is to be desired, but for the present we think the case calls for very vigorous measures.

We would recommend then, that, after the first spraying, and let that be a thorough one, at the time above indicated, another spraying follow, after an interval of ten

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days. Should rain have occurred within two or three days after the first spraying, another spraying should be given immediately, that the poison washed off by the rain may be replaced. The strength of the solution for all sprayings after the first, should be weaker than the first; 1 lb. of Paris Green to from 250 to 300 gals. of water, would be better than a stronger mixture, because of the increased leaf surface and consequent greater liability to burn the foliage. A third, fourth and fifth spraying, with intervals of twenty days between them, should follow the second spraying. A sixth spraying might be applied about the middle of August, and a seventh, on winter apples only, about the middle of September. This ought to suffice if the band system and destruction of windfalls, as outlined below, is faithfully attended to. Of course fewer or more sprayings are necessary according as to whether all or but few farmers in one locality patronize it. I have no hesitation however, in saying that *if every apple tree in one locality were thoroughly sprayed at the proper time, one application, or two at the most, would be sufficient.*

One caution is not out of place here, viz.: Apples on sprayed trees should not be eaten within three weeks of application of the poison.

The poison should be kept well mixed during application. To this end, and to insure a more even spreading of the fluid over the fruit, we would suggest the addition of 3 or 4 lbs. of soft or hard soap to each barrel of spraying solution.

Four gallons of the liquid ought to be enough for a good sized tree, and when that quantity of the poison is used, the cost per tree, for the entire seasons spraying, would be about seven cents. This includes the soap, the expense for which would be trifling, but does not, of course, include cost of labor.

Two extracts from the report of Prof. Forbes, of Illinois, who spent two years on this problem may be interesting; they are certainly to the point. Speaking of the examination of apples from poisoned trees and from others not poisoned he says:

"As a result of the examination of 2,418 apples from trees which had been sprayed with Paris Green, and of 2,964 others from check trees which had not been so treated, it appeared at the end of the season, that 21 per cent. of the poisoned apples had been infested by the codling moth and 67.8 of those not so treated."

And again, as a result of his experiments:

"Attending only to the picked apples and condensing our statement of results to the last extreme, we may say that under the most favorable circumstances, Paris Green will save to ripening at a probable expense of ten cents per tree, seven-tenths of the apples which must otherwise be conceded to the codling moth."

2. Bands. This goes hand-in-hand with spraying, the one supplementing the other. It consists in placing about the trunk of the tree two bands of twisted hay or burlap, the lower band about one foot from the ground; the upper band one and one-half feet above the lower. These bands should be on the trees from June 1st, until as late as Oct. 15th, and should be examined at least once in every five days; the larvae concealed under them should be killed and the bands replaced. The larvae or worms will be found to have made small oval white nests or cocoons between the band and the tree trunk. During the summer months they remain in

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this "cocoon stage" only a very few days before becoming moths, hence the necessity of frequent examination of bands.

3. **Destruction of windfalls.** Fence your orchard, if not too large, and let hogs range through it to pick up fallen apples containing the worms; and turn the poultry in to eat the straggling worms which have left the apples and are looking for a place in which to spin their cocoon. Sheep, if not heavily fed otherwise, are better than hogs for they are always on the alert to hear, and run to a fallen apple. They should be supplied with plenty of drinking water, otherwise they will gnaw the trunks of even old trees. This habit of gnawing the trees renders it unsafe to put them in a young orchard. *

In orchards too large to fence the windfalls should be gathered at least twice each week and destroyed by feeding to stock or otherwise. To insure the killing of the worm in these apples, and that none may escape it is desirable to boil the fruit before feeding.

4. **Killing in Storehouses.** Orchardists who have storehouses for their fruit, if they screen the windows and make the building otherwise moth proof, will find in the spring hundreds of codling moths escaping from their cocoons under barrel-hoops, in cracks of fruit boxes, etc., and flying about the store room. These can then be easily killed.

Buildings of this sort, more especially if they are not closed up as above suggested, should be carefully cleaned in March of each year, and all the cracks and crevices should be thoroughly wet with a solution made by saturating chloride of lime with all the coal oil it will take up and thinning with water until it can be applied with a brush. This will penetrate the white cocoons or nests and effectually destroy the larvae or pupae within.

5. **Disinfecting Fruit Boxes.** Boxes in which fruit has been stored through the late fall or winter, should, when emptied, be freed from any trace of cocoons by dipping for two minutes in a *boiling* solution of ¼ lb. of concentrated lye in 20 gals. of water.

WOOLLY APHIS OR WOOLLY LOUSE OF THE APPLE.

Familiar to every owner of an orchard. Found in colonies on both branch and root, and in either place looking like particles of bluish white down. If one crushes a colony under his finger, the latter is smeared with a red fluid which comes from the bruised bodies of the insect. This aphis, as well as others of the family, subsist on the juices of the trees affected, and the woolly aphis, when present in large numbers seriously weaken the trees, and even cause their death. An alarming feature in connection with this insect enemy is the marvelous rapidity with which it produces its young, the colonies spreading quickly from old neglected trees to some of the choicest in the orchard.

NOTE:—Mr J. S. Woodward, of Lockport, N. Y., has kept sheep from gnawing his young trees by washing the trunks once each month with a solution of soap-suds, whale-oil soap, and sheep manure, and giving them plenty of fresh water.

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REMEDIES.

See article on woolly aphis in Bulletin No. 3, in which cut of the insect is also found. The remedy given there, 1 lb. of concentrated lye to 3 gals. of water, has proved effectual.

Another excellent remedy is as follows: Melt 4 lbs. of rosin and add to it 3 lbs. of washing soda, then enough water to make 36 pints of the compound. Use one part of this compound to six parts of water. The above is for the branch form. For those frequenting the roots we would recommend the heaping of wood ashes plentifully about the base of tree. And gas lime about two shovelfulls placed around the tree so as not to touch the bark, is excellent. Should gas lime be used, place wood ashes between it and the tree and in contact with the trunk for two or three inches. This prevents infection from the root to the branches.

Cut off and burn all infested shoots coming from the roots.

GREEN APHIS.

The several species, and allied forms, are generally known. For remedies applicable to affected house plants in green houses and conservatories, see Bulletin No. 3.

For the aphids on the plum, prune, apple, turnip, cabbage, etc., use 1 pt. of the rosin compound (given under woolly aphis) to eight of water. Apply thoroughly as spray.

THE PEAR TREE SLUG.

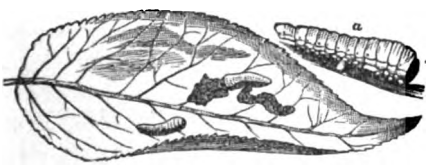


FIG. I.
Pear tree Slug on leaf. *a*, worm enlarged.

A small worm, a little over half an inch long when full grown, olive brown and covered with a slimy coating. It feeds principally on the leaves of the pear though found on the cherry, plum and other trees. It eats the upper side of the leaf causing it to wither and fall to the ground. The tree, having to put out new foliage, in consequence, is seriously weakened and the fruit crop impaired. See Fig. 1.

When the slug is ready to transform, it falls or crawls to the ground, enters it a few inches and shortly after changes to a four-winged fly, Fig. 2, which, in turn, lays its eggs in incisions it makes on the leaves.



FIG 2.
Saw Fly Producing Pear tree Slug.

REMEDIES.

Spray the tree, when foliage is full with a solution of one tea-spoonful of Paris Green to 2 gallons of water, using a syringe or watering pot for the purpose. Spray

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until the tree drips. This is a very effectual remedy. Fresh air slacked lime dusted on the leaves is good. Dusting the leaves with sand, ashes or road dust, will do some good, but the first remedy is the best. Fruit from the trees treated with Paris Green should not be eaten, of course, for some time after spraying. If no rain follows, two weeks or more should elapse before the fruit is used.

THE PEACH TREE BORER.

A pale yellow grub boring in the bark and sapwood of peach trees at the base about the collar and below. These grubs have a brown head and blackish jaws, and when full grown are half an inch long. Cherry trees and plum trees sometimes suffer from their attacks. Early in May, and probably in the latter part of April, as



FIG. 3
Male and Female Moth of Peach tree Borer and Larva and Cocoon.

well, the grub turns into a wasp-like moth which at once lays the eggs, usuallly near the roots of the peach trees, which produce the borers or grubs above mentioned. The colors of this moth are still blue and yellow and its wings expand from one, to one and a half inches. A copious exudation of gum from the tree, either just above the ground or just below it, indicates the presence of the grub beneath the bark. This is without doubt one of the worst pests with which Oregon orchardists have to contend.

REMEDIES.

With a knife remove the worm from under the bark in early spring and late fall. Plaster the wounds thus made with clay or wax. Then, to prevent the moth from depositing her eggs on the tree, heap leached ashes or sand round base to the height of twelve inches, or wrap tarred paper about the base of tree extending six inches up the trunk above the surface of the ground, and a few inches below the surface.

Carefully and frequently examine your young peach trees for the grub, looking even at the very base of the trunk below the ground among the roots for the gum which betrays the presence of the worm.

SAN JOSE SCALE.

This is a scale insect which from present reports, seems to be alarmingly on the

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increase and bids fair to give Oregon fruit growers as much trouble as it has caused in California.

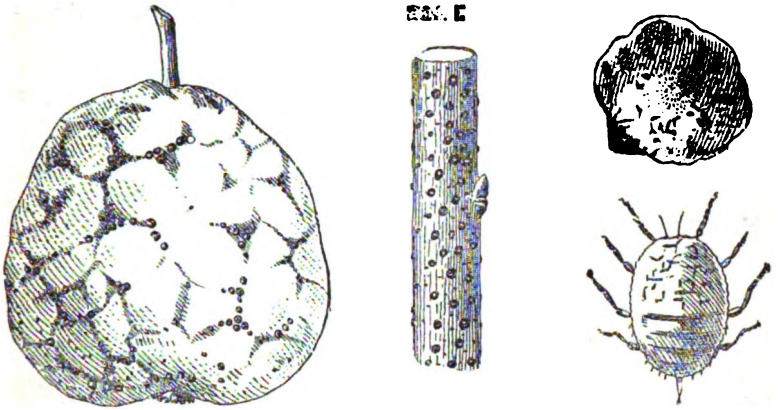


FIG. 4.

Infested Pear and Twig, natural size. The Scale and six legged Larva much enlarged.

The scale is round or oval, about 1-12 in. in diameter and gray, brownish or black and is found congregating in large numbers over branches, twigs leaves and even fruit. It is said not to touch the apricot but does work great injury to the apple, pear and many varieties of plum, prune and cherry. Where the insect is at work there are apt to be red blotches on the bark or fruit. See Fig. 4.

REMEDIES.

The best treatment of affected trees is undoubtedly made in the winter season when it is safe to apply to the dormant trees the stronger remedies mentioned below under winter washes. Nevertheless a remedy which has proved very useful can be applied in summer. This we will call the

SUMMER WASH.

(*a.*) Dissolve 1 lb. of concentrated lye in one gallon of water, add to this 1½ lbs. of sulphur and boil until sulphur is dissolved.

(*b.*) Dissolve 14 lbs. of the best whale-oil soap in fifty-four gallons of water, add solution *a* to *b* and boil for a short time. Use at 130° Fahrenheit, thoroughly washing the trunks and larger branches and spraying the smaller branches and twigs. The above should be applied when the first brood is hatching, about the time the cherries are turning red. About this time look sharply for the young, they are very small yellowish in color, and will be found creeping over the tree. (Fig. 4.)

When discovered use the above wash.

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WINTER WASH.

Dissolve 25 lbs. of Sal soda (carbonate of soda) in 25 gals. of water, heating it to boiling. When boiling add to it 1¼ gals. of whale-oil. Apply wash at 130° Fahrenheit.

Three weeks after application, wash the same trees with the following solution: 1 lb. American concentrated lye and ½ lb. of commercial potash dissolved in six gallons of water.

If the trees treated are very large, with much rough bark it will be found difficult to have the spray, penetrate to every part. Hence the need of most thorough work.

Messrs. Baldwin, Taylor & Co., 112 Front St., San Francisco, sell whale-oil for 42½ cents per gallon, and whale-oil soap for 3 cents per lb.

THE FLAT HEADED APPLE-TREE BORER.

This bettle is about half an inch long, somewhat flattened, an oblong in shape, and of a greenish black color. The under parts have coppery lustre.

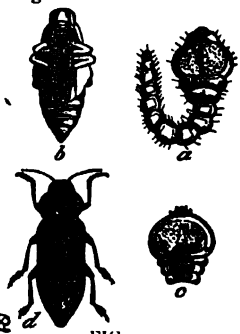


FIG. 5.
The flat headed Apple tree Borer *a*, larva or "borer," *b*, pupa produced from larva, *c*, head of borer, *d*, beetle produced from pupa. (after Riley.)

It lays its eggs during the spring and early summer in cracks and crevices, and under pieces of bark on the apple trees, especially affecting those parts of the trunks of young trees newly transplanted, which have been injured by the sun. It does not confine its attacks to the trunk alone, but also lays its eggs to some extent on the lower branches. It sometimes attacks the pear, the plum, and even the peach.

The egg, hatching, gives rise to the larva, familiarly known as the "borer," which works in the bark and sap wood, often causing great injury. The larva is a yellowish, footless grub, three-fourths of an inch long, with a large, flattened, somewhat rounded head. It bores in the solid wood as well as in the sap wood.

REMEDIES.

Protect the trunks of newly transplanted trees from sun-scald. Examine the trees in the fall and look for the borer where a dried patch of bark, a little oozing sap or sawdust-like castings indicate its presence. Remove it with the knife and kill it. Stop the wound with grafting wax.

In April or May, preferably in the former month, paint the trunk and lower branches with soft soap thinned to the consistency of paint by the addition of a solution of washing soda and a little crude carbolic acid, about one-half pint to a pailful of the mixture.

This should be repeated once or twice during the warm weather.

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During the winter months scrape the trunk and larger branches with a three cornered bark scraper, or what is known in meat markets as a block scraper. This removes the old bark in the crevices of which eggs are apt to be laid, at the same time it lays bare to the weather the cocoons or nests of the codling moth.

THE GOOSEBERRY FRUIT-WORM.

This is a green worm about three quarters of an inch long which feeds on the interior of gooseberries and currants. It will often bind, with its silk, a number of gooseberries and currants together and within this snug retreat feed at leisure.

A gooseberry so infested, if not very young, will turn red prematurely, or will, if very immature, become white and withered. These worms are very active and if disturbed will quickly let themselves down by a thread and hide among the leaves, etc., on the ground.



FIG. 6.
Cocoon and Moth produced by Gooseberry Fruit-worm.

REMEDIES.

Pick and destroy all berries coloring before they are matured. After the crop has been gathered, let fowls run among the bushes to seek out and devour the chrysalids or "nests" of the worm. Gather and burn all leaves and other rubbish collecting under the bushes, which might shelter the chrysales through the winter.

Then in the spring when the young fruit is forming, dust air slaked lime over the bushes, repeating it whenever a rain occurs which washes off the lime placed there before.

Or, and this is perhaps better, spray the bushes when the fruit is forming. two or three times at intervals with the following compound:

Boil 1½ gallons of water, add ⅓ lb. of sulphur and boil 15 minutes. To this add a pound of whale oil soap and boil for five minutes. Let stand for a week. When wanted for use mix 1 lb. of the compound to a gallon of water, and apply as a spray at a temperature of 130° Fahrenheit.

THE CURRANT BORER.

A bluish black moth, whose wings, when expanded, measure about an inch from tip to tip.

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The female lays her eggs on the stems of currant bushes, and often on those of gooseberries, the egg being deposited usually near a bud. The larva or "worm," on hatching, bores into the center of the stem and feeds on the pitch. It is in this discolored pith cavity, partially filled with castings, that the worm can be fonud.



FIG. 7.
Moth of Currant Borer.

It is half an inch long, white, with a brown head, and a few very small hairs are scattered over its body.

Stems containing the borer become so weakened that a light wind will often break them. Otherwise, somewhat withered leaves and poor fruit indicate the presence of the pest. It is said not to attack stems under one year old. In April or May the borer or worm transforms into a moth, which at once proceeds to lay eggs, from which new borers are produced.

REMEDIES.

During spring and autumn cut out and burn all affected stems. Be sure you burn them. Do this effectually. This pruning and burning prevents the spread of the insect.

Spray the bushes two or three times during April and May with the following mixture of sulphur and whale oil soap, viz: Boil ⅓ lb. of sulphur in two gallons of water for fifteen minutes; add 1 lb. of whale-oil soap and boil for five minutes more. Let it stand a week before using. Apply in some form of spray at a temperature of 130° Fahrenheit. This will keep the moth from laying her eggs on the bushes.

Further, the moths can frequently be caught and killed during the late spring and summer on cool mornings, when they are apt to be sluggish.

It would probably be impossible to completely exterminate this pest, but the above remedies will prove to be a great help.

THE FLEA BEETLE.



FIG. 8.
A Flea Beetle and its larva and pupa.

A small black beetle about ⅛ inch long, which feeds on leaves of turnips, cucumbers, beets, cabbage, etc. I have found them also on potatoe vines. When one attempts to catch them they escape by jumping, which habit gives them the above name.

REMEDIES.

Collect and burn in the fall and early spring all rubbish in corners of gardens which might offer a retreat for this beetle or its larva.

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Wood ashes dusted over the leaves drives them away. It has to be repeated. Sprinkling with a solution of lime is effective for the time being.

Sprinkling with a weak solution of Paris Green, 1 oz. to 8 gals. of water is recommended.

THE PEA WEEVIL.

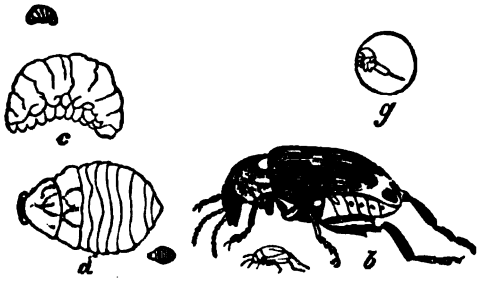


FIG. 9.
b, Pea Weevil enlarged and natural size. *c*, larva, *d*, pupa.

A small beetle about one-fourth of an inch long, grayish, mottled with black and brown, found in seed peas. A round hole is left on one side of the pea, and through this, in most affected peas, the insect can be seen snugly nestling within.

The eggs are laid on the pods of growing peas, and when the larvae or "worms" hatch they bore through the pods into the peas, there feeding until they transform into the beetle described above.

Neither the worm nor the beetle injures the germ of the pea, and infested peas are nearly, if not quite as sure to grow as those not touched.

REMEDIES.

Use care in selecting seed; a patch on a pea a little darker than the rest of the surface indicates that the insect is inside.

If infested seeds are placed, before planting, in an air tight jar, say a quart fruit jar a few minutes, into which two teaspoonsful of bisulphide of carbon has been poured, all the beetles will be killed and the seeds not injured. This method would of course, allow the seed to be planted the same season.

A second remedy is to soak peas in water poured from a boiling tea-kettle for two minutes before planting. Another way is for all the farmers in one neighborhood to omit planting peas one year, if seed is infected, and keep such seed in perfectly air tight vessels until the following season. This kills all the weevils, but the first and second remedies are plainly more practical. In using bisulphide of carbon do not bring it near a light.

A closely allied weevil, the bean weevil, is found in beans. The same remedies apply to it as to the pea weevil.

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THE STRAWBERRY CROWN BORER.

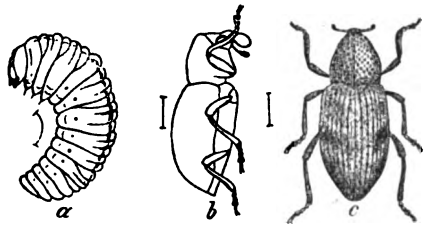


FIG. 10.

a, larva of Strawberry Crown Borer *b*, pupa, *c*, beetle. The lines beside the figures show natural size of insect.

This is a beetle about one sixth of an inch long, and brownish. Its white grub, about one-fifth of an inch long, has a horny yellow head, and bores down into the crown of strawberry plants. It infects chiefly old plants, and at present the only remedy known to us is to destroy old plants infested, or better, the whole bed directly after the fruit is gathered before the grub has time to turn into a beetle.

CUT WORMS.

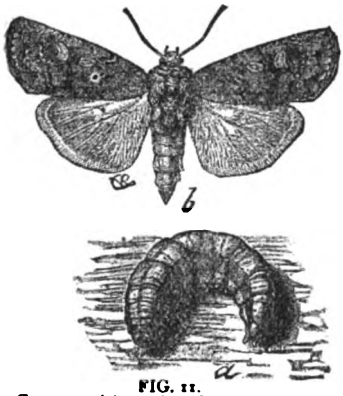


FIG. 11.

Cut-worm (*Agrostis cochranii*). *a*, worm, *b*, moth. (after Riley.)

These are the larvae of a number of different moths which fly at dusk and during the night. The worms are very destructive, eating the roots of strawberries, melons, cabbage, etc., and even climbing trees and vines and feeding on the buds. They are greenish, gray, brown or almost black, and smooth skinned. They work at night and hence are rarely seen.

The sudden wilting and death of a plant is an indication that a cut-worm has been at work there, and he can often be found near the scene of his depredations, not more than a few inches away, buried a short distance below the surface of the ground.

REMEDIES.

Sticking tender pieces of cabbage which have been staked in a solution of Paris Green and water about the infested plants is a very good remedy, and dusting air-slacked lime or ashes over plants will kill some.

Numerous holes with perpendicular sides made round a plant or tree will entrap many, which may be taken out and killed.

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Large cabbage leaves spread around the roots of infested plants furnish a good means of destroying them; the worms hiding under the leaves and not entering the ground. The leaves should be raised and the worms killed every morning.

Where trees are seriously threatened the worms can be prevented from climbing them by a piece of tin or zinc cut in a circular form and placed round the trunk, just above the ground, in such a way that it resembles an inverted funnel.

If trees are infested in early spring when the buds are opening, the cut-worms can then be jarred off the limbs upon a sheet placed beneath. This should be done about mid-night.

THE GRAIN BEETLE. (Silvanus surinamensis.)

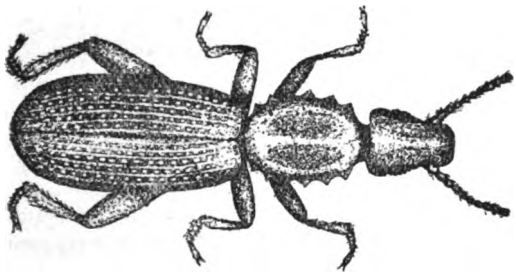


FIG. 12.
Silvanus surinamensis. Enlarged. (W. R. Hull, del.)

This beetle, about one-tenth of an inch long, and reddish brown, is shown much enlarged in Fig. 12 adjoining. It masquerades throughout this state under the name of "Grain Weevil." With it, in varying abundance are found true weevils, which are at present represented in this locality by the species shown in outline in Fig. 13. This weevil is considerably larger than Silvanus.

As flouring mills will not take wheat containing either of these beetles, or any trace of them, it has been a constant cause of expense to owners of granaries to rid their wheat of the pest.

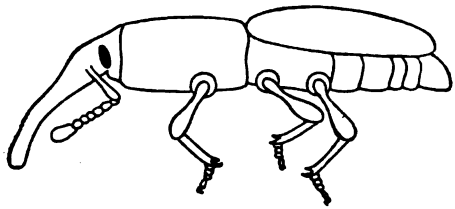


FIG. 13.
Calandra remote-punctata, in outline. Enlarged.
(W. R. Hull, del.)

If the wheat is allowed to heat ever so little, or if the granaries are not kept scrupulously clean, the beetles will thrive and depreciate the value of the grain to a considerable extent. Even when these conditions are not present, the little animals will get a foothold and defy the most streunous efforts to remove him. The first named beetle, (Fig. 12) infests not only wheat, but corn, bean. flour, and, it is said, sugar. It is reported to me also as being found in oats. They are found within the kernels in the larva or "worm" stage and in the resting or pupa stage.

The beetle feeds on the interior of broken kernels. A mass of wheat which shows no evidence on the exterior may be infested in its warmest and dampest part with thousands.

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The cost of freeing wheat of the beetle, where the conveying is done by steam, is about ½ cent per bushel.

REMEDIES.

The general remedies for both of these pests, when found in stored grain, the result of work done in California and elsewhere, were published by us in various papers a few months since and we repeat them here.

1. Keep granaries clean and dry within, and well ventilated.

2. Whitewash the interior in the spring of each year.

3. Grain in storehouses or granaries should be piled so as to allow a free circulation of air around the rows of sacks, (supposing that sacks were used, and their uses seems desirable.)

4. Thorough ventilation is important, that a low temperature may be maintained.

5. Grain kept in bulk should be turned over occasionally by "shovelling" to prevent its becoming heated.

6. Stored grain should be kept free from damp, and kept perfectly covered to prevent its becoming wet from rains, etc; avoid a high temperature by every possible means.

7. When flour or middlings in sack are infested with Silvanus, place sacks in sun and sweep off and kill beetles gathering on outside.

Some of the methods to be adopted by grain men in the valley to secure the above ends, are as follows:

When storing wheat one bin is to be left empty. This will allow an opportunity to occasionally turn over the wheat in all the other bins, transferring from one bin to another. This seems to be an excellent plan. The cost of this process, including services of engineer, fuel, etc., is estimated to be about one-tenth of a cent per bushel.

Another idea to be put into execution is to run a Λ shaped tunnel, covered with wire screening part way through the bin at the bottom, opening to the exterior on the side of the granary; its inner end in the bin, terminating in a wooden flue bored full of two inch auger holes, which are covered with fine wire screening. This flue to run up through the bin or bins, affording with the above mentioned tunnel a current of cool air through the wheat. The opening of the tunnel on the side of the granary may need a little roof to prevent entrance of rain. This method of ventilation is already in use in some sections.

In remedy number three above, applicable to those who can afford it, and who are willing to mend after the mice, the sacks should be so disposed that cats frequenting the granary can have means of passing through the spaces intervening between sacks or rows of sacks. This will give them a chance to lessen the number of mice.

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EXPERIMENTS AT THIS STATION.

It is apparent from what has been said before, that the main object to be attained is to find some inexpensive and effectual remedy not to kill the beetles in the grain, which would necessitate further cleaning by the grain merchant, but to either prevent its entering the grain or to cause it to leave that already infested. Camphor and bisulphide of carbon have been suggested, the latter very effectual under some conditions. It was to test the efficacy and practicability of applying these and other agents in granaries of the state that a series of experiments, lasting through a period of three months, was begun here. The following is a report of the beginning, only, of these experiments. It is the intention of this department to continue the experiments another winter.

A minature bin was built, 2 ft. by 2½ ft. by 3 ft., by "cribbing" with split laths. A small square opening was made in the floor in one corner to allow of the grain being drawn off. The bin was whitewashed without and within, and placed on a stout table in a room whose average day temperature was 68° Fahrenheit. The object of this procedure was to subject the wheat to the same conditions, though on a smaller scale, which it is subject to when stored in granaries in bins 12x14x22 feet, and in a temperature favorable for the beetles' working. This bin was then filled with ten bushels of wheat infested with both of the above beetles, though only scattering individuals of *Calendra remote punctata* (Fig. 13) were seen. The description of this bin is given here that the reader may understand references below; most of the following experiments, however, were made in wide-mouthed jars holding 1 pint, and in 2 oz. bottles.

A. TO DETERMINE TO WHAT EXTENT THE ACTIVITY OF BEETLES IS DEPENDENT UPON TEMPERATURE.

Several hundred beetles (Silvanus) were placed in pint jars with a supply of wheat. The top of jar was covered with veiling to prevent their escape, and a Fahrenheit thermometer for recording temperature attached. The experiment ran through two weeks with the following results: 69°, beetles very active. 64°, active. 60°, fairly active. 56°, sluggish. 57° (but observations made in morning after a cool night, and only one hour after fire was started) semi-torpid.

B. KILLING BY DROWNING.

Exp. No. 1. A specimen of Silvanus kept in water in open glass bottle 72 hours without drowning.

Exp. No. 2. Four beetles in water as above. Water shaken up once. In 18 hours all were dead.

Exp. No. 3. Several beetles put in water as above indicated. Bottle not shaken. Examined after 3 hours, all alive. After 31 hours, one or two still alive. All dead the following day.

The reason for this experiment will be seen later.

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C. EFFECT OF GUM CAMPHOR.

Exp. No. 1. Seven specimens put in open wide-mouthed bottle containing wheat, with a small piece of camphor the size of a pea. Alive after 19 hours. All dead after 60 hours.

Exp. No. 2. Seven or eight beetles placed in wide mouthed 2 oz. bottle half full of wheat. The bottle was left open except for veiling over top, and beneath the wheat was placed a piece of camphor the size of a pea. After a few minutes the beetles hurriedly left the wheat and ran up the sides of the bottle, evidently in some distress. They remained at the top of the bottle just without the rim, under the veiling for one week, alive, without returning to wheat.

Exp. No. 3. In 2 oz. bottle half full of wheat containing beetles, a very small piece of camphor the size of a pin head was placed. No effect.

Exp. No. 4. 2 oz. of gum camphor ground to size of coffee grains and divided into three equal parts. One part strewn over bottom of bin above described. One part strewn over wheat after one third of the wheat had been put in; and one part strewn over wheat after the second third of the grain had been put in. The bin was then filled with the remaining wheat. Pieces of bagging were pinned around the outside of bin near the top to afford a hiding place for bettles leaving the grain. The daily temperature average, just outside of bin was about 74°. During the night it would naturally fall much lower. After 24 hours, bagging removed and a large number of beetles found congregating beneath. A slight but plainly perceptible odor of camphor discerned on moving top of wheat, which odor was more perceptible if one brought up handfuls of wheat from the center of the bin, about sixteen inches below surface. Handfuls of wheat brought up in this way contained numerous lively beetles.

Bin then left for a few days, and again examined. Some active beetles in center of wheat and a large number in the corners. A strong odor of camphor in bin. The numbers of beetles found throughout the wheat indicate that they are not very seriously affected by the odor of camphor.

D. EFFECT OF CONTACT WITH KEROSENE.

Kills in two minutes.

E. EFFECT OF KEROSENE VAPOR.

Exp. No. 1. At bottom of pint jar 2 teaspoonsful of kerosene on sponge. Over that a little paper and cotton to keep grain from coming in contact with sponge. Then some wheat containing a number of beetles. After 5 days no marked effect.

Exp. No. 2. About 2¼ oz. of kerosene put in a pint jar, as in Exp. No. 1. After 15 minutes the beetles left the wheat and hurried to veiled top. Next day all still living.

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Exp. No. 3. 2 oz. of kerosene placed in each of six bottles with wide open tops. These placed in bin in two planes, three near bottom and three midway between top and bottom. Each bottle in upper plane came over the space between two bottles in lower plane. The tops of bottles were veiled to prevent wheat falling into coal oil. This was March 10. March 17 bin examined, wheat not removed. But few beetles found. This result probably affected by the fact that the beetles are getting much less numerous on account of many and repeated experiments.

F. FUMES OF BISULPHIDE OF CARBON.

Exp. No. 1. On February 26, about 2 oz. of bisulphide of carbon put in lower part of bin near the center, in wide mouthed bottle. Bin emptied and wheat examined February 28. Beetles much fewer on sides and through wheat. No odor of bisulphide. On the bottom of the bin were hundreds of dead beetles.

Exp. No. 2. ½ oz. of bisulphide of carbon placed in pint jar, and jar half filled with wheat. Beetles in wheat killed at once.

Exp. No. 3. About 2½ oz. of bisulphide of carbon placed in bin March 4, pretty evenly distributed in four places near bottom of wheat by pushing a somewhat pointed ½ in. glass tube down through the grain and pouring the liquid into tube. March 5, a number of beetles found to have left the wheat and gone under sacking. No odor of bisulphide given off surface. Bin emptied March 7, three days after application. Sides of bin seem considerably freer, yet a large number are still scattered through wheat. I should judge that their numbers are somewhat lessened.

Exp. No. 4. About 1 teaspoonful of bisulphide poured on bottom of pint jar, then wheat containing beetles, separated from the liquid by pieces of muslin. All killed by vapor in about three minutes.

G. TO SHOW RATE OF EVAPORATION OF BISULPHIDE OF CARBON AS COMPARED WITH THAT OF KEROSENE.

One watch glass filled with pure kerosene (1.) One watch glass filled with 3 parts kerosene and 1 part bisulphide (2.) One watch glass filled with pure bisulphide of carbon.

In about 16 hours. (1) 1–20 gone. (2) ⅓ gone. (3) all gone.

H. LIQUID APPLICATION OF BISULPHIDE OF CARBON.

Kills if thoroughly applied. But not so deadly in this form of application as kerosene.

I. TO DETERMINE HOW SMALL A PROPORTION OF BISULPHIDE OF CARBON MIXED WITH KEROSENE WILL KILL BY VAPOR.

The three jars in which the following proportions were placed, were pint jars with

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wide open tops. About two handfuls of wheat containing many beetles were put in each and kept from contact with the liquid.

(*a*) 1 part bisulphide, 20 parts kerosene. Kills in 30 minutes.

(*b*) 1 part bisulphide, 20 parts kerosene. Kills in 15 minutes.

(*c*) 1 part bisulphide, 6 parts kerosene. Kills in 6 minutes.

J. TO DETERMINE WHAT EFFECT TREATMENT OF WHEAT WITH BISULPHIDE OF CARBON, CAMPHOR, AND KEROSENE HAS UPON BREAD MADE FROM THE WHEAT.

In the case of wheat treated with bisulphide of carbon, the grain was thoroughly wet with the liquid and confined, thus, in an air tight jar for one week, then aired for about the same length of time. The wheat was then ground and sifted and made into graham gems. No taste of bisulphide.

In the case of wheat treated with camphor, the method of procedure was practically the same, a large quantity of gum camphor being confined in jar with wheat. No taste of camphor in bread. Wheat subjected to kerosene vapor for one week, then aired and cooked entire, tasted very slightly indeed, of kerosene. Wheat confined in air tight jar and thoroughly wet with kerosene for one week, then aired, ground and made into graham gems. Tasted strongly of kerosene, as might have been expected. These were, of course, very rigid tests.

K. EXPERIMENT TO TEST SEED QUALITIES OF GRAIN TREATED AS IN EXP. J.

Wheat subjected to kerosene vapor grows well.
" " " " liquid " "
" " " camphor " "
" " " bisulphide " poorly, at least much more slowly than the three preceding. The above is the result of one experiment. The effect of bisulphide of carbon will be tested further in this respect.

L. EFFECT OF VAPOR OF CRUDE CARBOLIC ACID.

1 teaspoonful in pint jar for three days. At first fumes did not affect beetle, but subsequently, by March 24, beetles had left wheat in jar and congregated at top as far from grain as possible.

M. AN EXPERIMENT TO TEST THE ACCURACY OF A STATEMENT MADE BY GRAIN MERCHANTS.

I have been repeatedly told that *any* wheat, though apparently free from the beetle, grain which shows no trace of it whatever, will, if kept in a moderately warm temperature, generate the insect. To test this rather startling assertion, we half filled two wide mouthed bottles with some fine looking wheat sent us for that purpose.

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Veiling was put over the top of the bottles, and the wheat moistened from time to time. One bottle was kept in a temperature the daily average of which was 71° Fahrenheit. The other in a slightly cooler place, averaging 57°. The experiment lasted from January 9 to the last of March, with temperature observations three times a day during January, from which the above averages are computed. No result beyond the fact of the wheat sprouting. Three other jars of the same wheat, not so carefully watched, gave the same result.

MISCELLANEOUS OBSERVATIONS.

A number of individuals of Silvanus, which had left bin, were found clustered on pieces of potatoe, evidently feeding with relish. This was frequently observed.

It should be noted, in considering the effects of the different agents used in preceding experiments, that the disturbance incident to preparing the experiments, would of itself cause the beetles to leave the wheat and crawl to the top of jar or bin, but where they persistently keep away from the wheat, then it is fair to presume that the agent used is repugnant.

Kerosene and bisulphide of carbon, when mixed, form a clear homogeneous liquid, readily spreading over white washed surfaces.

Messrs Langley and Michaels of San Francisco, sell bisulphide of carbon at 35 cts. per 1 lb. bottles, or a 6 lb. bottle for $1.50. Doubtless other wholesale dealers offer the same rates.

DEDUCTIONS.

One could not with justice, draw many and broad conclusions from the foregoing experiments, but a few things are evident which may be safely stated.

The temperature of stored wheat should be kept below 50° Fahrenheit.

The throwing of beetles when cleaning wheat, into standing water in the street or elsewhere, is not a safe means of disposing of them; (see B.) A large per cent will escape drowning and return to molest your wheat. It would be far better to burn them.

The vapor of camphor does not appear to be very effective. We, however, intend to experiment further with it.

The fumes of bisulphide of carbon are certainly very effective if distributed through the wheat, and the liquid is so extremely volatile that the grain is not injured for bread making. Moreover, from work previously done with this agent we are loath to believe that it injures the grain for seed, if properly used. The test above cited which resulted apparently in checking the growth of the seed, was unnecessarily rigid, purposely so, and not likely to occur in actual practice. Just how practicable this remedy is for granaries is a subject for further experiment. It is so effective that it would probably kill large numbers in the grain, which is not desired.

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The vapor of kerosene or some more volatile allied liquid, as gasoline may accomplish something, if means are devised, for suspending firmly, in different places and at different heights through the wheat, open vessels (the mouths of which are covered with gauze) containing the liquid.

It is evident (from F No. 1) that however volatile a liquid may be, the vapor cannot penetrate effectually through a large and heavy mass of wheat, hence the necessity of having the liquid located in various places through the wheat. This might drive beetles out of infested wheat and keep them away during the few months the wheat is in storage.

After emptying a bin infested with the beetle, spraying the sides thoroughly with a mixture of kerosene and bisulphide of carbon (see I; also D) to kill the beetles that cling to sides in large numbers, seems desirable. A small and inexpensive spray pump or syringe, costing only a few dollars, would prove effective, and the liquid would quickly evaporate.

As regards the idea of "spontaneous generation" (?) (see M) it may be said that while some wheat which appears perfectly free may contain the larva or pupa, which will develop into beetles under proper conditions, it is absurd to make a general statement to the effect that all non-infested wheat will show the same phenomenon.

Owing to the very evident technical difficulties attending experiments of this character, and the limited time, the results are necessarily meagre. We should be pleased to hear expressed the views of the grain merchants of the state.

ADDENDA.

After the manuscript for this Bulletin had gone to press the following additional remedies were received from excellent authorities, and, through the courtesy of the printers, are inserted here.

For the Flea Beetle. Take two large handfuls of tobacco dust (this can be procured very cheaply from tobacco factories), and pour boiling water upon it. Sprinkle this over infested plants. One pound of tobacco to two gallons of water are good proportions and have proved very effective.

For the San Jose Scale. Resin 2 lbs. caustic soda, 1 lb., boil in about 30 pints of water. Then add tallow 1 lb. This amount of soap costs 11 cents. When wanted for use add 2 gallons of water to 1 pint of the soap. Apply in spray. This is cheap, easily used, and applicable for both summer and winter. The solution might be made weaker or stronger than the above, according as to whether the trees are very young or old.

As many scales, concealed under bark, moss, etc. will escape the first spraying, it is well to give a second a month later, and possibly, if necessary a third spraying two months after the second.

For Cut-worms. Spray a piece of grass or clover thoroughly with London Pur-

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ple or Paris Green; cut it and strew it, when fresh, thickly in bunches (not more than one or two rods apart) over the infested piece of ground. Where tomatoes and cabbages are to be protected, distribute this poison just before the plants are transplanted. If corn is threatened the poisoned grass or clover is distributed just before or just after the corn is up. It is said that poisoned cut-worms will bury themselves a short distance in the ground before they die; do not expect, therefore, to find the ground strewn with dead worms after application of poison.

For the Grain Beetle. Advance sheets for the annual report of Prof. Cook, of Michigan, contains the following remedies for *Silvanus surinamensis*, resulting from work he has done with this beetle.

Where the beetles are in a small bin or a barrel and bisulphide of carbon has been introduced by means of tube, pipe or otherwise, a piece of oil cloth or a carriage robe spread over the top of bin or barrel will be a help. Prof. Cook suggests using a piece of gas pipe with a rod inside to keep it from being filled with grain when pushing it to the bottom, with drawing the rod from the gas pipe when the bisulphide is to be poured in.

It has been found that paper smeared with lard or other grease and placed where the beetles were very plenty, will attract a great many and they can then be easily destroyed.

From another source: A sudden heat (175° Fahrenheit) will destroy them. This is hardly practicable in granaries.

During the mating season, usually soon after winter, large numbers can be caught by spreading sheep skins, with fur down, near the grain.

The above additional remedies for the flea beetle and cut-worms were taken from Prof. Cook's report.

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ZOOLOGY.

F. L. WASHBURN.

GOPHERS AND RABBITS.

The many letters received at this station asking for remedies for the Pocket Gopher, one of the worst pests with which the Oregon farmer has to contend, prompt us to reply by publishing the means now used to lessen their numbers and thereby decrease the injury done by them. Discussion of the Jack Rabbit and remedies therefor will be taken up at the end of this article.

The Pocket Gopher of this coast, while practically the same in its habits and injurious qualities as the Pocket Gopher of the Eastern States, is not identically the same, and, on account of structural and other differences, is placed in a different genus.

The injuries caused by our gopher are almost too well-known to need mention here. The mounds of dirt which disfigure our garden lawns and meadows are evidences of its presence, and its otherwise hidden burrowing. It attacks nearly all root crops. It will frequently nearly, or quite girdle young cherry trees after eating the roots, leaving nothing but a lifeless stub in place of a thrifty tree.

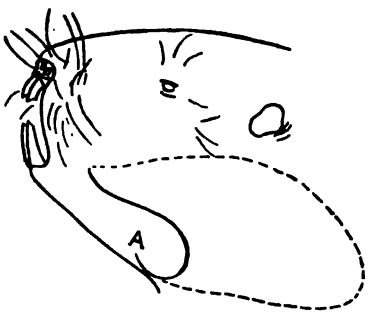


FIG. 14.
Outline of head of Pocket Gopher. The dotted line indicates the extent of the pocket, which opens at A.

Its winter nest is very apt to be among the roots of apple trees, it finding there an abundant and easily accessible food supply in the shape of roots. It is said to be very fond of and destructive to alfalfa, when that is sown in ground suitable for its burrows. Whole garden crops of potatoes have been destroyed by its ravages.

REMEDIES.

A.—MECHANICAL.

1. **Gopher Traps.** Of iron, about eighteen inches long with a strong spring which drives two prongs through the back of the animal, can be purchased for about $1.00. They are, when set, thrust down the open hole of a gopher, the hole being en-

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larged a little with a trowel if necessary. Gophers come to the surface during the night and early in the morning, and again about noon and again late in the afternoon, and it is at these times, when the branch burrow is open that the trap should be set, though one could, and some do, dig down to the main burrow and set the trap there. In the latter case two traps are really necessary, setting one on one side of the spading and the other on the other side, so that from whichever direction the animal may come, he finds a trap. The trap is sprung by the animal touching a plate with his nose or head.

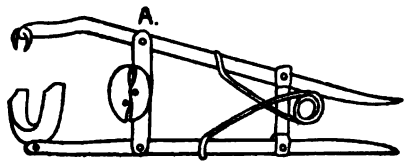


FIG. 15.
Gopher trap.

We have tried a limited number of experiments with this trap, and found invariably, that the gopher would spring the trap before reaching it, by pushing loose earth against the plate. This was the case whether the hole was closed with sod and the light thus excluded, or left open. Until we have tried this trap further, we hardly feel qualified to give a just opinion on its merits, yet, from the work we have done with it, we fear there are technical difficulties in connection with its use, which, combined with the wariness of the animal will prevent its being perfectly successful.

2. **Shooting.** A handy shot-gun is really very effective. One will often, at about noon, or late in the day, find himself close to a gopher burrow from which, if not disturbed, the animal is at intervals, showing his head. A few pellets of shot at such a time will put an end to him.

3. **Wire Netting.** Where injury to young, newly transplanted trees, is extensive, it is suggested as a remedy that, in the hole dug for the reception of the tree there be placed a wire netting in the shape of a cylinder, two feet in diameter, and two feet in depth. The upper end of this should be from four to six inches below the surface. The mesh might be ¼ in. Black iron is preferable to galvanized iron because it is cheaper, and would not last longer than three years at the farthest, by which time the roots would be large enough to withstand any attacks. Though rather expensive, this is said to be effective.

4. **Pitfalls.** The following excellent plan comes to us from California to be used in districts very much affected:

Dig a trench around the land to be protected the width of a spade and about sixteen inches deep; in this, about 100 feet apart sink five gallon oil cans, their tops, from which the tin has been removed, level with the bottom of the ditch. The ditch must not be of course, any wider than the cans. Gophers travel at night and, on trying to come into the inclosure tumble into the ditch, and run along until they drop into the cans. Prof. Wickson, of California, says: "As many as fifteen live gophers have been found in one can." These trenches should be made about July 1st, or when the animals rush from the drying vegetation outside to the cultivated areas.

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B.—POISONOUS GASES.

1. **Sulphur.** A "smoker" or "sulphur gun" can be obtained, home-made, of the local hardware establishment for about $1.00. See Fig. 16 A, adjoining. This gun is made with two pieces of stove pipe, the one fitting inside of the other, and working up and down over the other piece, the latter being held firmly with its pointed end in the hole by one hand grasping the long handle, while with the other hand, one pumps, as it were, the fumes down the burrow. B, in the figure represents a perforated disk fitting into a smaller pipe, and held in place near the lower or conical end. It is on this plate that one places peices of old woolen rags which are set on fire. Upon this burning mass is poured powdered sulphur. When the gun is extended the air rushes through the hole in the top. When the gun is shut, this hole is closed by a leather valve within and the air is forced through the burning sulphur into the burrow. This treatment is most effective when the ground is damp. We are inclined to think favorably of this means of ridding a place of gophers. As far as it goes it is certainly effective, and we are convinced that in a number of cases of its use here it has either killed the animal or driven it away.

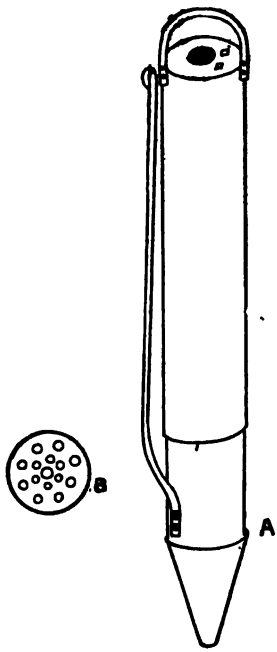


FIG. 16.
A "Smoker" or "Sulphur Gun."

2. **Bisulphide of Carbon.** This is a very volatile liquid, which can be purchased from druggists in one pound bottles. It should never be brought near a light, as it is extremely explosive. Saturate a piece of cotton half the size of one's fist with this liquid, thrust it into burrow as far as possible and stop the opening tightly with sod and earth. This remedy has been used successfully against the so-called ground squirrel and has been mentioned as a possible remedy for the Pocket Gopher. We have personally tried it on the latter and think it has been effective. We would reserve, however, our final judgment until further trial. Bisulphide of Carbon, like the preceding, is best used when the ground is damp.

C.—POISONS.

1. **Poisoned Wheat.** This agent, so successfully used against the "ground squirrel" or gray gopher, is sold by druggists in tin cans. The Wakelee brand is considered the best in the market. In the case of the ground squirrel, a few grains are placed at the entrance of the burrow, and the same procedure has been recom-

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mended in the case of the pocket gopher. This poison is not expensive. It should be used in the early spring. If used later the animals would leave it for more succulent roots, etc. It is said to partly lose its effectiveness by lying for a length of time on damp earth, hence it would be well to place it on some natural object—a stone, a piece of stick or the like, when putting it at the entrance of burrows. It should of course be carefully kept away from children and others ignorant of its use.

2. **Strychnine.** We have found this very efficacious. Wholesale druggists sell it either powdered or in crystals in ⅛ oz. vials at the rate of $1.10 per oz. Retail dealers charge much more, about 35 cents per ⅛ oz. vial. A ⅛ oz. vial full of the poison, will, if properly used, last a long time. It would be far more economical for a number of farmers to unite and purchase one ounce (eight vials) at wholesale. If the crystals are purchased they can be easily reduced to a powder by means of an iron nail. We have poisoned pieces of potato with powdered strychnine and used it to very good advantage.

A piece of potato, twice the size of the end joint of ones thumb, is poisoned by introducing into two or three slits in it, a very small amount (barely what one can hold on the very tip of the knife blade) of the strychnine powder. Then a spoon tied to a small stick serves to introduce it for some distance into the hole. Gophers are passionately fond of potatoes and, apparently, eat the poisoned pieces with avidity. Mr. Clark Walters, of Athena, says:

"I have killed very many gophers by putting poisoned potatoes on the end of sticks and thrusting them down their burrows. So eager are they for the potato that they will often consume that part of the stick which is moistened with the juice."

In the experiments here, the poison was put out about noon, or in the afternoon when the animals are bringing out earth or, perhaps, nibbling what grass they can reach from the burrow opening. This opening is the opening of the branch burrow, which extends a foot or two in a slanting direction into the main runway, so it has been a comparatively easy matter to run the spoon down into the main burrow. Of course there are opportunities for failure in this method as in every other; the gopher may be pushing a lot of earth before him and shove the bait out of the hole before he has scented it, rendering it useless, hence the first attempt may be unsuccessful occasionally; but do not be discouraged, it may be necessary to try them several times. To render bait more attractive it might be touched with the cork from a bottle containing oil of rhodium. It is well to put two pieces of the potato in each runway, inserting, by means of the long-handled spoon, one piece on one side of the branch burrow, and a second piece on the other side.

Further, the poison might be disguised by making a syrup of sugar and water and adding the strychnine with perhaps a drop or two of oil of rhodium.

Strychnine is a deadly poison and we cannot be too careful with it, especially in a household where there are children. Keep it under lock and key, and intrust its use to no one who is not perfectly responsible and well aware of its dangerous qualities.

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THE GRAY GOPHER.

This squirrel-like gopher (Spermophilus beecheyi) masquerades in this state and in California under the name of "ground squirrel." It is on the border line, as it were, between the squirrels and gophers, though really belonging to the latter family. Its wide spread devestations are too well-known to need comment here. Our wheat crop and fruit trees especially, are the sufferers.

REMEDIES.

"Smokers" or "sulphur guns" used as above outlined. Bisulphide of Carbon when the soil is damp, as directed for the pocket gopher, and poisoned wheat, are all effective.

To prevent "ground squirrels" from gnawing fruit trees or climbing the tree after the fruit, a California orchadist suggests tying newspapers round the tree trunk in such a way that four inches of the paper at the upper edge extends out. The rattling of the paper when the squirrels attempt to cross it will frighten them.

THE JACK RABBIT.

This rabbit and a few of its congeners which have been such a scourge in California, bid fair to be nearly as great a pest in parts of this state. Young fruit trees are the principal sufferers by their depredations.

REMEDIES.

A.—MECHANICAL.

1. **Protecting the Trees.** One thickness of burlap wrapped about the trunks of young fruit trees has proved perfectly successful in parts of Eastern Oregon. This is cheap and easily applied.

2. **Fencing.** The adjoining cut illustrates a wire net fence in successful use in California and cheaper than any kind of board fence serving the same purpose. The netting is galvanized wire No. 19, with a mesh of one and one-half inches. The posts are driven into the ground, around the piece to be inclosed, at intervals of ten

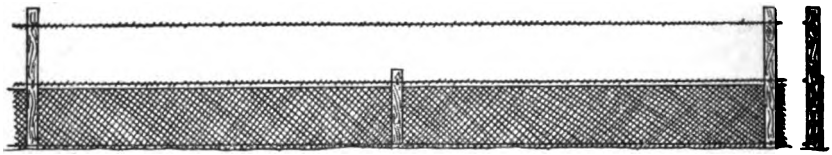


FIG. 17.
A combined Rabbit and Cattle Fence.

feet. If rabbits alone are to be feared, all of the posts should project from the ground two and one-half feet, but if the fence is to be used also as a protection against cattle, every other post should be from four to four and a half feet high.

The above cut is taken from Wickson's "California Fruits," and a poorly engraved reproduction of the original.

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The netting is fastened to the posts, *on the inside, toward the inclosed piece, this is very important*, with small staples. Its lower edge lies along the ground. The ground in the vicinity of the fence is left hard, and not ploughed, otherwise the rabbits might dig under through the softened dirt. A barbed wire with barbs about 2 in. apart is stretched from post to post *on the outside, and just clear of the surface of the ground* (*these two points are important*) and fastened with staples to the posts. A *similar* wire, also *on the ontside* is stapled to the posts *just cne inch above* the netting. And, if the alternate posts have been left long, and a cattle fence is desired, a third wire is stretched from post to post near the top, *on the outside*. The exact cost of this fence is hard to determine; it would vary in different localities. Wire netting, 2 in. mesh, costs in Portland about 2¼ cents, per sq. foot. Barbered wire, as on opposite page, 6 cents per lb. There is a fraction over one pound in one rod.

B.—POISONS.

Pieces of poisoned melon scattered plentifully through a young orchard have proved effective in Eastern Oregon. Strychnine is the poison used. The rabbits prefer the melon to the bark. Any vegetable of which they are especially fond might be used where melons are lacking.

The following receipts are recommended as making very effective poisons:

(*a.*) Add 9 gals. of water to 100 lbs. of wheat. To this add 1 lb. of phosphorus, 1 lb. of sugar, and 1 ounce of oil of rhodium. Bring to a boil, and let stand all night. The next morning stir in enough flour to make a kind of paste. Scatter this over ground frequented by the animals.

(*b.*) ½ teaspoonful of powdered strychnine, 2 teaspoonfuls of fine salt, 4 teaspoonsfuls of granulated sugar. Shake well together in a tin box. If placed on boards this becomes hard and rabbits lick it eagerly.

(*c.*) **Rabbit Drives.** Thousands of rabbits are killed in California by driving them, by means of lines of horsemen into fenced enclosures and killing them with clubs.

NOTE.—An ingenious trap, said to be in successful use in parts of Oregon, has been described to us as follows: A piece of ground about 15 feet square in locality infested by rabbits, is surrounded by a board fence, high enough to prevent their jumping over. On one side a board plank runs from the ground, with an easy slope, to the top of the pen, and projects a foot over the inclosure. Above this projecting end and just enough in front of it to cause the animal to reach, lose his balance and fall into the pen, is hung some tempting bait. A little bait is scattered around outside of pen and along the plank to attract the rabbits. We cannot judge of the efficacy of this contrivance, never having seen one, but our informant, a reliable party, asserts that they have been in successful use. F. L. W.

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DEPARTMENT OF CHEMISTRY.

P. H. IRISH, Chemist. W. D. BIGELOW, Assistant.

ANALYSIS OF BONE MEAL.

This substance is obtained by cracking up and grinding dry bones.

These contain as material valuable for fertilizers, phosphate of lime and certain complex substances containing nitrogen. The phosphate is the chief constituent, forms the frames of the bone, and is what might be called the mineral portion of the same.

The other plant food contained in bone belongs to that class of matter from which the plant obtains the material necessary for building the so called albuminoid substances, such as the gluten of wheat, and the legumin of the pea to which those substances owe their nourishing and flesh forming qualities.

The more finely divided a fertilizer is, the more valuable it is, on account of the greater readiness with which it goes into solution. Hence in determining the value of a fertilizer, the mechanical analysis is of considerable assistance.

The two samples of bone meal sent to us by Miller Bros., of Portland, showed on analysis the following composition.

ANALYSIS NO. 29.

Bone Meal from Glue Factory.

Moisture on drying at 100° C. (212° F.)	8.28 per cent.
Phosphoric acid	22.59 "
Nitrogen	3.15 "
Equivalent to ammonia	3.80 "
Sand, etc	2.16 "

ANALYSIS NO. 31.

Wickersham Bone Meal.

Moisture on drying at 100° C. (212° F.)	5.61 per cent.
Phosphoric acid	24.03 "
Nitrogen	3.01 "
Equivalent to ammonia	3.65 "
Sand	1.98 "

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MECHANICAL ANALYSIS.

Amount held back by sieve No. 8 (8 meshes to one inch)						.61	per cent.
"	"	"	"	"	" 16	27.60	"
"	"	"	"	"	" 26	17.41	"
"	"	"	"	"	" 40	20.44	"
"	passing			"	" 40	34.49	"
						100.55	"

The above analysis would seem to show the two samples of bone meal to be of about average composition.

Fertilizer Control. At present there is no hindrance thrown in the way of dishonest companies placing upon the market worthless or poor fertilizers. The increasing use of these articles through the state would seem to show a necessity for fertilizer inspection, and would suggest the wisdom of a law compelling all fertilizer companies whose goods are offered for sale, to submit them for examination to some competent chemist to be appointed by the state, and obtain his certificate as to their compositions before placing them upon the market.

Until some further provision is made for this work, the Station will as far as time and means allow, examine, and report upon samples of commercial fertilizers sent to them. *Provided*, All samples sent shall contain at least one pound, be sent, carriage paid, in *clean*, tight tins or glass vessels, be taken from a lot of not less than one ton. The sample to be obtained as follows: From each parcel in the lot a small amount is to be taken, these several amounts placed upon a clean surface, thoroughly mixed and from this mixture the sample taken, placed in the tight vessel, sealed, and forwarded without delay. *Provided*, Also that the name of the fertilizer, a statement of the amount of fertilizing material guaranteed by the manufacturers, together with the name and address of the dealer, from whom the material was obtained, be forwarded.

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OREGON

Agricultural Experiment STATION.

BULLETIN NO. 6.

CHEMISTRY:

I.—Examination of Cattle Foods.

ECONOMIC ZOOLOGY:

II.—Circular No. 1. General Information.

FOR JULY, 1890.

The Bulletins of this Station are sent free to all residents of the State who request them.

PORTLAND, OREGON:
SCHWAB BROS. PRINTING AND LITHO. CO.
1890

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HORTICULTURE.

Comparative Tests of some Small Fruits and Vegetables

GEORGE COOTE.

The following paper gives only the first results of experiments planned to give the farmer and fruit grower of Oregon, or rather of the Willamette valley, information to guide him in selecting the varieties which may be expected to do best on the valley lands.

During this fall, preparations are being made to carry these experiments farther and to embrace many more kinds of fruit and vegetables.

Experiments are also in course of being carried out in testing the results of grafting the favorite fruits, now being so extensively planted in western Oregon, on to different stocks from those hitherto used.

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No doubt this is mainly due to the fact that it is not generally cut early enough. This grass, like many other varieties, passes the point for making the best hay very quickly. When it begins to turn brown it is beyond the best stage for hay. If grown for hay this grass should be sown very thick, not less than ten to fourteen pounds of seed to the acre.

T. A. Cole, Madison county, N. Y., in the *New York Tribune*, says: *

"After twenty years' experience, I have settled down upon Orchard Grass as possessing greater merits than any other, for both pasture and meadow, for fattening animals or for dairy stock. When cut for hay, just before bloom, and cured with as little sun as possible, it will make more milk than any other variety known to me; if left to ripen it is worthless."

Further notes on Orchard Grass will be found under remarks on pasture grasses.

Next to the Orchard Grass, perhaps, we would place the Tall Oat Grass. This produced a large yield of hay which, when cut at the proper stage, is of very good feeding value. Like the Orchard Grass, this grass should be cut early with no delay, for it changes very rapidly after blooming. For wood land pasture and for valley pasture as well, we believe the Oat Grass has many advantages; for it withstands long continued drought better than many of the finer growing sorts.

The matter of growing early maturing grasses becomes of very great importance, throughout a large portion of the State. Those varieties which will grow rapidly, and mature from the moisture which remains in the soil from the winter rains, will be most successful. The growth of timothy, because of the lack of moisture, was very materially checked last season. The growth of the red tops, except on moist land, was also materially shortened by the lateness of the season, at which they start to grow and reach maturity. Common red clover, which is several weeks earlier than the mammoth red clover, made a larger growth owing to the dry weather affecting the latter, after the common red clover had reached maturity.

Such varieties should be grown as will reach maturity before the dry season begins. The average rainfall during the months of April, May

*Beal's Grasses of North America.

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and June, is very low throughout a large portion of the valley, and for this reason the moisture which remains over from the winter rains must constitute the principal source of moisture for plants.

The English or Perennial Rye Grass, made a larger growth than the Italian Rye Grass, both on the white land and on the higher dark land; and the English Rye Grass made an excellent second growth as well. Of the grasses which produce a good, firm sod on the white land, there are none which have done better than the *Agrostis Stolonifera* (creeping bent grass). This grass grows close to the ground, the stalks not reaching more than a foot in height at any time. The leaves are very fine, and the tufts spread rapidly, forming a thick mat which would withstand much treading by stock, no doubt. At this date, March 1st, there is no grass on the white land, that produces a better sod than the Creeping Bent Grass, hence for pasture purposes this grass is worthy of a more extended trial.

Texas Blue Grass (*Poa Arachifera*), has made a good growth during the past year, and has spread very rapidly, until now it covers the entire plat, and is sending up shoots in the path which surrounds the plat. While the stalks sent up are thinly distributed over the plat, the ground is well covered with leaves, which grow at the base.

This grass starts early in the spring and maintains a green, fresh growth throughout the dry weather, and has kept green all winter. This variety of grass has proved valuable in some of the States where a hotter climate prevails; and so far its indications are favorable for a pasture grass, throughout a large portion of this State. More seed has been procured, with a view of testing the value of this grass on a larger scale. The habit of the grass is to send out numerous shoots from the root stalks, thus enabling the plants to spread very rapidly.

Of the grasses which were grown on the white land, Tall Fescue gave the largest yield of hay, and Musquit next; but neither of these were as good in quality as Orchard Grass, Oat Grass or Red Top, all of which did fairly well. Hard Fescue, Italian Rye Grass, and Meadow Foxtail, are thinly set, and did not give as large a yield as some others. *Avina Flavescus* (Yellow Oat Grass) has made a better sod on the white land than the Tall Oat Grass, and it starts earlier than the latter and keeps green later in the season. These grasses which grow in tufts or bunches, would give better results if sown in a mixture;

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and in fact there are very few of the grasses that would not give better results if sown in this manner. A mixture of grasses, makes a better quality of hay, and more pasture of a better quality, than when the same varieties are sown separately.

Timothy and Alsike Clover, sown in mixture, made a good set, and yielded a large amount of hay of excellent quality. These were sown upon land just bordering on the white land. The Aliske Clover matures later than the common Red Clover, hence is better adapted to sowing with Timothy. There is a strong objection to sowing Aliske Clover from the fact that it is inclined to fall down, and become entangled so much that it is difficult to cut and cure. The timothy helps to support the clover, thus preventing its falling on to the ground.

While the results of the plat experiments are valuable, as being indicative of more or less success in practice, yet definite conclusions can not be reached, until a more thorough trial has been made in the field. For this reason a series of plats, consisting of several acres each, will be seeded with different varieties of grasses and clovers, and a mixture of these, to determine their value in a more practical way.

YIELD OF GRASSES AND CLOVERS FOR HAY.

An effort was made to test the yield of several varieties of clovers and grasses for hay, the results of which are found in the table. The grass was cut when it was thought to be at the proper stage to make the best quality of hay. The first weight was taken immediately after the grass was cut, and the second when the grass was sufficiently dry to make good hay. The weather was very favorable during the time that the grass was exposed. The yields, as found in the table, from the small plats on the dark land were very large in many instances; but the small areas should be taken into account in studying the results given. They were practically all grown on the same kind of soil, and under the same conditions. The plats varied in size, but the most of them were 10 by 30 feet.

It will be noticed that the early maturing grasses and clovers gave the largest yield, excepting the Meadow Foxtail and Sweet Vernal grasses. These were thinly set and were past the stage for giving the best results. The plats on the white land were about 1-16 of an acre in size.

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There has been some inquiry regarding the growth of Alfalfa. Small plats were sown to Alfalfa, but has not done as well as some of the clovers. The dry weather injured the Alfalfa, more than it did the common clovers. Throughout the valley, where the soils are undrained, and are what is termed heavy, I do not think Alfalfa will be a success.

PASTURING.

Five sheep were confined on some of the plats, at different intervals, to determine something regarding the power of the grasses to start again after close pasturing. Orchard grass possesses this requisite to a remarkable degree. This grass was pastured, until there were no green leaves in sight, and then allowed to recover, which it did in about four week, producing an average growth of eight inches. It was again pastured to the ground, after which it was allowed to start, and it made an average growth this time of five inches, before being checked by the dry weather.

The Musquit, Rye grasses, and the Brome grasses were not so readily eaten, as the other varieties which were pastured. While the Tall Fescue is a coarse grass, it was closely cropped, and seemingly very much relished by the sheep. Sheep's Fescue and Meadow Foxtail were only fairly well eaten, however, the latter was too far matured for the best results. The Oat grasses were readily eaten, and put forth a very vigorous second growth.

This matter of testing grasses for pasturage is an important one, and one which we shall pursue further, hoping to reach results that will be of some benefit to those who are interested in producing good permanent pastures.

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TABLE SHOWING YIELD OF HAY AND LOSS IN WEIGHT BY CURING.

NAME OF VARIETY.	Date of cutting, and weighing green.	Weight of Green Grass per acre.	Date of weighing when cured for Hay.	Weight of cured hay per acre.	Per cent. of loss in weight by curing.	Height of Grass in inches.	Time exposed.
		LBS.		LBS.	PER CT.	INCHES.	HRS.
Meadow Fox-tail	May 22, 8:30 a. m.	5928	May 23, 1:30 p. m.	3006	49	30	29
Sweet Vernal	" 9:00 "	7014	" 2:00 "	2421	65	16	29
Orchard Grass	" 9:30 "	10098	" 2:00 "	4851	52	34	28½
Tall Oat Grass	" 10:30 "	18455	" 2:00 "	9686	48	50	27½
Meadow Brome Grass	" 11:00 "	12692	" 2:00 "	6513	49	40	27
English Rye Grass	" 11:30 "	14336	" 2:00 "	7896	45	24	26½
Yellow Oat Grass	June 2, 9:00 "	12648	June 4, 1:30 "	5248	59	30	52½
Italian Rye Grass	" 3:00 p. m.	9424	" 2:00 "	4960	47	30	47
Tall Fescue	June 3, 3:00 "	26040	June 5, 3:30 "	10788	59	42	48½
Red Clover	" 3:00 "	23808	" 4:00 "	8432	65	30	49
English Blue Grass	" 3:40 "	9176	" 3:40 "	4712	49	36	48
Awnless Brome Grass	" 4:00 "	14314	" 3:40 "	7316	49	36	47⅔
Mosquit	" 4:30 "	12876	" 3:40 "	5050	61	26	47⅓
Alsike Clover	" 5:00 "	17546	" 3:30 "	6076	65	28	46½
Mammoth Red Clover	June 28, 8:00 a. m.	19152	June 30, 9:00 a. m.	6676	65	28	49
Alfalfa	" 8:00 "	14265	" 9:00 "	5118	64	36	49
Timothy	" 8:00 "	14136	" 9:00 "	4898	65	22	49
Red Top	" 8:00 "	14260	" 9:00 "	5270	63	21	49
Red Top	" 8:00 "	12710	" 9:00 "	4736	63	21	49

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YIELD OF HAY PER ACRE ON WHITE LAND.

	DATE OF CUTTING.	DATE OF WEIGHING.	LBS.
Tall Fescue	May 23.	May 26.	4808
Hard Fescue	"	"	1608
English Rye Grass	"	"	2080
Italian Rye Grass	"	"	1680
Tall Oat Grass	"	"	2248
Meadow Foxtail	"	"	1040
Orchard Grass	"	"	3624
Yellow Oat Grass	June 4.	June 6.	1816
Mosquit	"	"	4256
Red Top	July 2.	July 4.	3536

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NOTES ON POTATOES.

OBJECTS OF THE WORK.

A large number of varieties of potatoes were grown on the station farm, for the purpose of obtaining some varieties which would prove more valuable than the varieties generally grown throughout the State. Many of the varieties were grown, only in small plats, while others were grown in large enough area to warrant a computation of the yield per acre.

Another object in the future will be to classify, so far as possible, this large number of so-called varieties, under a few names or types. The casual observer would see at once that there are many of the named varieties, which are alike in every particular, so far as practical results are concerned. To have a large number of names for practically the same variety, is very misleading indeed.

METHOD OF CULTIVATION.

The potatoes were grown on the dark loam found on the upland of the valley. No manure was applied, except in the plats mentioned. The ground was prepared by plowing and harrowing thoroughly. The seed was cut into pieces, having two and three eyes, and one piece was dropped into each hill; and the hills were placed three feet apart in the rows, which were furrowed out three feet apart, and four inches deep.

No effort was made to hill up the potatoes; level cultivation is thought to be the best. This is a point which has been very well established in practice, but is not universally adopted. When we think of the matter carefully, we are bound to see that the ground kept level and stirred frequently on top, will hold the moisture better than when thrown up in ridges; and, moisture coming to the ground in the form of rain, will reach the roots better, if the ground is kept level. Some may think that the potatoes are more exposed in the hill, if the dirt is not thrown up, but this is not the case, if the potatoes are planted at a good depth. A small five-trothed iron cultivator was used for the most part, in tending the potatoes.

KEEPING THE SEED.

The early varieties came up very poorly, owing to the seed having

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sprouted too much before planting. The seed potatoes were stored in a basement which was too warm. Too much care cannot be taken in preventing the seed from sprouting; for very much of the vitality of the seed is lost if it is permitted to grow sprouts six inches or a foot in length. When the soil is very moist, at the time of planting, the injury is not so great; but if dry weather, and a rather dry soil prevail, much of the seed will fail to send out new shoots.

Seed stored in barrels, partially filled, may be shaken every few days by turning the barrels over a number of times. This will break off the sprouts already started, and thus discourage the growth for a time. Seed intended for use this season has kept very satisfactorily by storing in a basement, where there is a free circulation of air from out doors.

NOTES ON VARIETIES.

Notes on vigor of growth, etc., were taken on all of the varieties, but they will be reserved for the most part until future tests have been made. Of the varieties which have been grown for two successive seasons, and promise satisfactory results, we will mention only a few in particular.

The Garfield, a medium early potato, is one of the most promising varieties grown. This has a white, russety skin, with shallow eyes; is a very good yielder, and a vigorous grower. The tubers lie very close in the hill, making an important item in the harvesting. The tubers were seldom exposed to the sun. Cut No. 1 represents this variety.

Alexander No. 1, very similar to the Garfield, is a very prolific variety, and a vigorous growing sort. For quality there is very little difference in these two varieties. Alexander No. 1 is given in cut No. 2.

No. 3 is a cut of the Early Sunrise. This is one of the best early varieties grown in large enough area to test the yield. The Early Sunrise is one of the earliest sorts grown, and produces edible potatoes earlier than any other early variety tested. Although the tubers may be only partially grown they are comparatively free from the soggy condition that prevails in most varieties at this stage. The skin is slightly flesh colored, but the flesh is very white and clear. Cut No. 4 represents the Rural New Yorker, No. 2, a medium early variety. This potato has a fine appearance, and is one which has given general

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satisfaction wherever tried. It has a white, slightly rough skin, shallow eyes, and is uniform in size and shape.

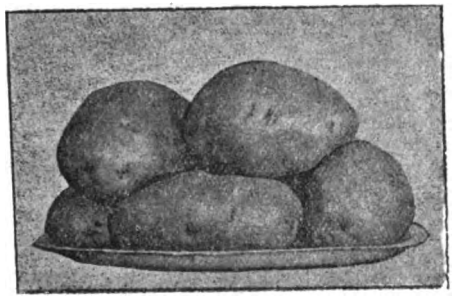
Cut No. 5 was introduced more for its negative qualities than for its merits. This type of potato is one which should be little grown. No high-sounding name should induce the farmer or market gardener to grow such a rough potato as this. At a glance, one can see that one-half of the potato would be lost in dressing, on account of the deep eyes. If cooked with the "jacket" on, the deep eyes are still a great hinderance in cleansing. Some of the rough, coarse varieties are very prolific and vigorous, and on the strength of these qualities are highly advertised. Such varieties should be purchased with caution, until the quality has been thoroughly tested. This cut represents the variety known as Garner Chili. It is given as a type, which is characteristic of many varieties. The deep eyes are not well shown in the cut.

There are two varieties, grown in small quantities, which indicate very good results. One of these, Rochester's Favorite, resembles the Burbank Seedling somewhat, except it is not quite so long, and has a little thicker, rougher skin. It may be a little earlier in ripening, but there is very little difference in this particular.

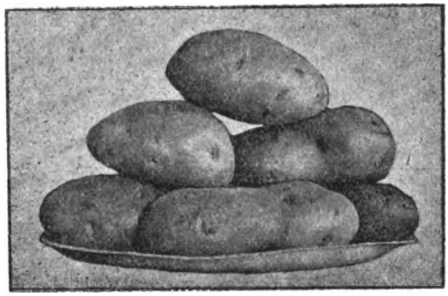
Another variety, which gives promise of very good results, is Watson's Seedling. This is an early maturing variety, which is smooth and uniform in size, a good yielder, and a vigorous grower. The skin is flesh colored, and the inside is very white and free from any black spots In other States this variety has done remarkably well, and the indications are very favorable for it here at the station.

At the end of the present season the station will have a sufficient supply, of some of the leading varieties, to furnish enough seed for a test in various parts of the State. It is the object of the station to send out to the farmers of the State, any of these new varieties which promise to excel the varieties already grown.

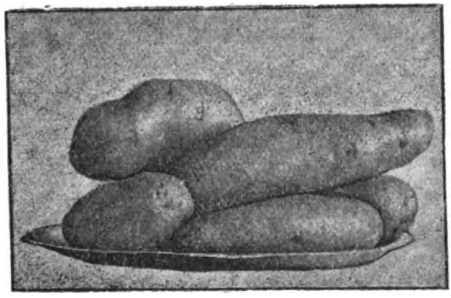
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NO. 1.

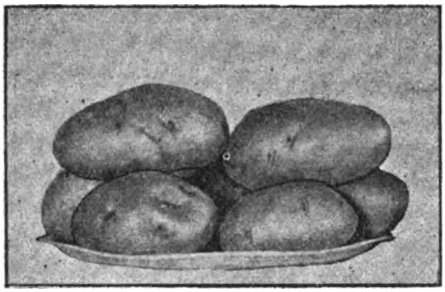


NO. 2.

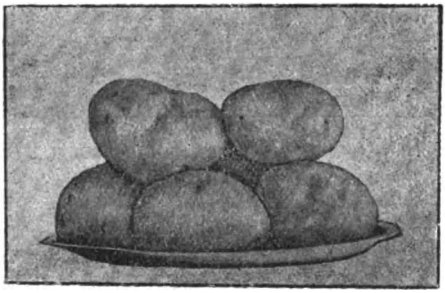


NO. 3.

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NO. 4.



NO. 5.

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TABLE No. 1.

NAME OF VARIETY.	No. of Plat.	Date of Planting.	Date of Harvesting.	Yield in bushels per acre.	REMARKS.
O. K. Mammoth	1	April 30.	October 11.	84	Medium early.
Rural New Yorker	2	"	"	73	Medium early.
Dakota Red	3	"	"	94⅔	Late, flesh color.
Alexander's Prolific	4	"	"	64	Medium early.
State of Maine	5	"	"	122⅔	Late, skin white.
Munroe County Prize	6	"	"	74⅔	Medium early.
Early Sunrise	7	"	"	122⅔	Best early potato.
Grenado	8	"	"	47	Medium early.
Early Rose	9	"	"	125⅓	One of best standard sorts.
Garfield	10	"	"	160	One of best medium early.
Late Rose	11	"	"	56	Not desirable.
Jumbo	12	"	"	164	Prolific coarse potato.
Alexander, No. 1	13	"	"	133⅓	One of the best.
Carter's Superior	14	"	"	96	Medium early.
Thunder Bolt	15	"	"	64	Rather coarse.
Salzeis Iron Clad	16	"	"	81⅔	Late, white, smooth.
Jone's Prize Taker	17	"	"	78⅔	Medium, early variety.
Perfect Peachblow	18	"	"	109⅔	A very promising variety.
Peerless	19	"	"	125⅔	One of the best late sorts.
P. E. I. Rose	20	"	"	58⅔	Not desirable.
Duchess	21	"	"	156	Very late, flesh colored.
White Star	22	"	"	106⅔	Good, white potato.

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Rural Buttercup	23	"	"	72	Medium, early variety.
Early Dawn	24	"	"	69⅔	Early, not very productive.
Charles Downing	25	"	"	78⅔	Early and prolific.
Early Mayflower	26	"	"	81⅔	One of best early, white skin.
Garnet Chili	27	"	"	81⅔	Coarse, undesirable.
White Seedling	28	"	"	97⅔	A promising late sort,
California Peachblow	29	"	"	58⅔	Medium early.
Big Creek Seedling	30	"	"	69⅓	Poor quality.
General Logan	31	"	"	90⅔	Large and good quality.
Seedling, No. 50	32	"	"	80⅔	Late, white skin.
Lady Finger	33	"	"	92	A novelty.
Silver Skin	34	"	"	110⅔	White and smooth, medium early.
Crown Jewel	35	"	"	57⅓	White skin.
Green Mountain	36	May 1.	"	130⅓	Good, white-skinned variety.
Imp. Beauty of Hebron	37	"	"	93⅓	Good, early variety.
Burpee's Superior	38	"	"	98⅔	A promising variety.
Tunic	39	"	"	102	Medium, early, very smooth.

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FERTILIZER TESTS.

In table No. 2, the results of the application of commercial fertilizers are given. The fertilizer was applied, when the potatoes were planted, by spreading it in the furrows, and then carefully working it into the soil with the hoe. The lightest yields are given in case of the Nitrate of Soda, and the Kanite (Sulphate of Potash). These manures are too strong for the young shoots when applied in this manner. The Mexican Guano gave the best results, as seen in the table. There was a marked distinction in the vigor of growth of the potatoes, where this fertilizer was applied. Mape's Potato Fertilizer is next in value as show by the increase in yield. The Bone Meal would have given better results, no doubt, had there been more moisture during the season. Another experiment was tried, by preparing a deep trench, and applying Mape's Potato Fertilizer and the Mexican Guano, at the rate of 1,200 lbs. per acre. The dirt was thrown out of the trench, to the depth of eight or ten inches, and the soil loosened in the bottom of the trench several inches deeper. Then the fertilizer was sifted into the trench, and well mixed with the soil. In mixing the fertilizer with the soil the trench was partially filled. The potatoes were then dropped in the trench, and covered even with the surface. In this experiment the M. P. Fertilizer gave the best results, as seen in table No. 3.

DIFFERENT AMOUNTS OF SEED.

An experiment was tried to test the effect of planting whole potatoes compared with seed cut into pieces having one eye, and two and three eyes on each piece. Five pounds of seed was cut into pieces, having only one eye on each piece. The pieces were dropped in furrows, one piece in a place, making the hills about a foot apart.

The second plat was planted with the same amount of seed, cut to two and three eyes, and seed placed eighteen inches apart in the row.

Plat No. 3 was planted with five lbs. of whole potatoes, which were dropped three feet apart in the row.

Five pounds of seed cut to one eye extended over one-third more ground than the whole potatoes, and one-fourth more ground than the two and three eye pieces.

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The yield is given in table, and is slightly in favor of the one eye plant. Seed cut to one eye will extend over more ground, and if the conditions are favorable good results will follow. If the soil is too dry there will be some danger of the pieces drying up before they can send out shoots. The potatoes were more uniform in size from the one eye plat. This experiment and fertilizer experiments will be tested further during the coming season.

TABLE NO. 2.

Kind of Fertilizer.	No. of Plat.	Yield per Acre in Bushel.	Increase in Yield.	Amount of Fertilizing Applied.
No Fertilizer . . .	1	95 1-2	------	------
Mape's Potato Fertilizer	2	186 4-5	91⅓	200 Pounds per Acre.
Super. Phosphate . .	3	172 2-5	76½	" " " "
Kanite	4	127 1-2	32	100 " " "
Bone Meal	5	168	72½	200 " " "
Nitrate Soda	6	110	14½	100 " " "
Mexican Guano . . .	7	211 1-2	116	200 " " "

TABLE NO. 3.

No Fertilizer	1	192	------	------
Mape's Potato Fertilizer	2	265 1-3	73⅓	1200 Pounds per Acre.
Guano	3	208	16	" " "

TABLE NO. 4.

		Lbs.		
One Eye Plat	1	68 1-2	------	5 Pounds of Seed used.
2-3 Eye Plat	2	56 1-4	------	" " " "
Whole Potato	3	52 1-4	------	" " " "

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LIST OF POTATOS.

O. K. Mammoth Prolific,
Thorburn,
Sunlit Star,
Early Rural,
Sus. Favorite,
Potentate,
Rose's Beauty of Beauties,
New Queen,
Early Essex,
Harvest Premium,
American Giant,
Seedling No. 54,
Princess,
New Zealand,
Illinois,
Triumph,
Clark's No. 1,
Early Ohio,
Crane's June Eating,
Everett,
Great Eastern,
Tioga,
Surprise,
Zoar,
Yarrow,
White Rose,
Red Lady Fniger,
Vanguard,
White Whale,
Rose's Wild,
Touhock's Extra,
Washington,
Wisconsin Peachblow,
Sunbeam,
White Cloud,
White Peachblow,
Superior,
Veteran,
Siberia,
Sultan,
Roxbury,
Yankee Flat,
White Lion,
Wisconsin Beauty,
Waverly,
Twilight,
Red Jacket,
Plymouth Rock,
Winslow,
Yankee White,
Red Flour Ball,
Trophy,
Star Russett,
Standard,
Watson's Seedling,
Prairie Giant,
Peruvian,
Early Maine,
Reno,
Medley,
Paragon,
Tennessee White,
Patagonian,
Valley Queen,

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Portland Russett,
Sun Dog,
White Lily,
Vane,
White Diamond,
Yucatan,
Saturn,
Vermont Fancy,
N. Y. Red,
Old Carter,
O. K.,
Prairie Flower,
Trotter,
Astonisher,
Mexican Merino,
Prince Albert,
Norman,
Olympia,
Lango,
Summit,
Little Giant,
Ox Horn,
Siloam,
Pecan,
Michigan Genuine,
Prairie Farmer,
Marvel of Beauty,
King,
White Superior,
Red Star,
Big Benefit,
Prodigy,
Adirondack,
Early Puritan,
Late Superior,
Late Shaw,
Mountain Queen,
Old Merino,
Mississippi,
Quito,
Red Lion,
Planet,
Wall's Grange,
North Star,
Legal Tender,
Mikado,
N. Y. White,
Lackawana.
Kent,
Parson's Prolific,
Multiplier,
Red Whipple,
Phœnix,
Nubian,
Magnolia,
New Champion,
Pride of the Field,
Old Pinkeye,
Manhattan,
Pootatuck,
Royal Red,
Seneca Wonder,
Pike's Peak,
Persian Red,
Rocky Mountain Rose,
Magic,
Pacific,
No. 33,
New Alpha,
Rubicund,
Odd Fellow,
Prize,
Knoxville,
Blue Victor,
Breakfast,
Polaris,
Rural N. Y. No. 2,
Old Orange,

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Putnam,
Otto,
President,
Cuban King,
Bon Bon,
Amazon,
Mormon,
Altumot,
Badger State,
Clipper,
Bermuda,
Boston Blue,
Baby Elephant,
Baraboo White,
Newland,
Late Vermont,
National,
Rocket,
Alexander's June,
Sultan's Flour Ball,
London Lady,
Patterson's Irish Blue,
Amsterdam,
Lapwing,
Merrimac,
Brownell's Superb,
Advance,
Lewiston,
Luxury,
Bannock,
Old Michigan Red,
Nigh's Early Standard,
New England Favorite,
Leviathan,
Calico,
Black Jack,
White Magic,
American Pinkeye,
Wig Wag,

Mex. Giant,
Sedan,
Mars,
Rogers' No. 4,
Rochester Favorite,
White Victor,
Arlington,
Pride of Mason,
Red Snow Flake, Early,
Zoo,
Queen of the Valley,
Montana Rose,
Primrose,
Traveler,
Valley Queen,
Vallentine,
Zulu,
Spotted Shaw,
Rockland,
Stray Beauty,
Whipple's Pinkeye,
Tilden,
Squaw,
Seneca Chief,
Canada White,
Canadian,
Riley,
Antwerp,
Telegraph,
Zig Zag,
White China,
Saxon,
White Granger,
Yankee Notion,
Kidney,
Atlantic,
Matchless,
Strawberry,
Triumph,

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Tyrean Purple,
Wonder of Bath,
White Ladyfinger (same as Foxeye)
Spartan,
Granger,
Evening Star,
Interior,
Falcon,
Biscuit,
James Vick,
Charter Oak,
Dunstan,
Gladstone,
Central American Wild,
Fleetwood,
Fortune,
Gen. Sherman,
Bananna,
Duke of Edinburg,
Blue Peachblow,
Blue Mayflower,
Burling,
Corrian,
Early English,
Champlain,
Dublin Chief,
Gem,
Climax,
J. G. Blaine,
Continental,
Cal. Mercer,
Oneida,
Gipsey,
Arctic,
Egyptian,
Eutaw,
Churchill's Seed,
Brownell's Best,
Gould's White,
Belle,
Cook's Choice.
Carpenter's Seed,
Derby,
Acme,
Addison,
Bismarck,
Irish White,
Comforter,
Blue Cowhorn,
Gen. Stark,
Corless Matchless,
Bright Eyes,
Dover,
Bingham,
Cayuga Chief,
Harvest Home,
Dandy,
Farmer's Delight,
Champion,
Durkman,
Baker's Imperial,
Boston Market,
Keepsake,
Invincible,
Eureka,
Defiance,
Brownell's Beauty,
Cherokee,
Honey Dew,
Drummond,
Davenport,
Old Fluke,
Crandall's Seed,
Gem of the Valley.
Early Mohawk,
Delaware Russett,
Carter's Early,
George III,

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Jerusalem,
Howard,
Household,
Enterprise,
Early Duster,
Hemlock,
Garnet,
El Paso,
Eclipse,
Chicago Market,
Gleason,
Fawn,
Galva,
Concord,
Highlander,
Jones No. 8,
Conqueror,
Huguenot,
Dutch Merino,
Elkland,
Corona,
Eng. Rose,
Italian,
Early Date,
Dakota White,
Arabian,
Caucassian,
Calumet,
Japan Wild,
Early Peachblow,
Java,
Blue Eye Peachblow,
Great Britain,
Hollander,
Columbia,
Blue Point,
Dolphin,
Irish Grey,
Dakota Boss,
Commander,
Dawn,
Ethiopian,
Imperial,
Drew,
Home Comfort,
Early Shaw,
Irish Cup,
Eng. Peachblow,
Jersey Lily,
Ironsides,
Challenge,
Bristol Baker,
Herald,
Irish Red,
Captain,
Jersey Blue,
Gold Drop,
Cream of the Field,
Jewell,
Capricorn,
Old Chili,
Crane's Keeper,
Clifton,
Buffet,
Fox Eye,
Plum,
Rochester Seedling,
Royal Green,
Sweet,
American Magnum Bonum,
Grasgaw,
Early Morn,
Jordon's Prolific,
Chili Pinkeye,
Berks,
Dunmore's Seedling,
Ionia.

Total, ... 375

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Oregon Agricultural

Experiment Station.

BULLETIN No. 12.

HORTICULTURE.

GEO. COOTE, Horticulturist.

Comparative Test of Strawberries for 1891.
Meteorological Summary.

The Bulletins of this Station are sent free of cost to all residents of Oregon who request them.

CORVALLIS, OREGON:
AGRICULTURAL COLLEGE PRINTING OFFICE.
1891.

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STRAWBERRIES.

The object of the tests of strawberries recorded below, is to determine the varieties that may be grown to the best advantage, on the average soil of the Willamette Valley.

We have experimented, in all, with twenty-seven varieties.

In some instances, we have found many of the qualities claimed by the introducers, while others fall very short of their description. Those that have hitherto failed to meet the requirements, fitting them for general cultivation, will be given another trial, in order to discover such special characteristics as they may possess, as well as to avoid premature condemnation.

To ascertain the difference of yield between the two systems of planting, viz., the hilled and the matted, two rows of each variety, with twenty-five plants in a row were laid off. One row was allowed to mat by letting all runners grow; while from the other row of the same variety, all runners were removed.

Careful notes were taken of the manner of growth, vigor, time of blooming, time of ripening and productiveness.

The soil—a basaltic loam—was well prepared before the plants were set out, it being finely pulverized by continued cultivation and subsequently by supplying a liberal quantity of well rotted stable manure. Owing to the late rains of last spring the crop was materially damaged by mould, resulting from excessive moisture, the injury being made more manifest towards the end of the season.

The fruit produced by the different varieties that have borne

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may be considered under two heads, first the provisions made by nature which may be either structural or physiological and second the natural forces that act as aids in distributing the plants. Under structural provisions we may have modifications of the fruit such as pappus of which the thistle down carried by the wind is a familiar example, hooks as in the Burdock (*Arctium*) by which the burs fasten themselves to the hair of animals and are thus carried from place to place, or modifications of the seed as in the coma or hair of Cottonweed (*Epilobium*) and Milkweed (*Asclepias*).

Under physiological provisions we may have prolonged vitality of the plant, a seed covering attractive to birds, or a sticky exudation as in the Tarweed (*Madia*). Of natural forces aiding in the distribution of plants we may name, winds, streams, birds, cattle and last though not least the agency of man.

That railroads are a great factor in weed distribution is apparent to all who have noticed the great number and variety of Eastern plants growing along these lines of traffic. The seeds of many plants are annually emptied upon our shores in the ballast left about sea-ports by vessels from foreign countries, or come over the mountains in the straw and chaff used for packing goods. Some of our worst weeds are thus brought from a distance but many come from neighboring fields or roadsides and by ocupying valuable space and appropriating food from the soil lessen the yield of crops and if allowed to ripen seed will reappear in greater numbers the next season.

CO-OPERATION IN THE DESTRUCTION OF WEEDS.

Sometimes they spread so rapidly as to require concerted action to destroy them; to this class belongs the Canada thistle which spreads both by seeds and by underground stems rendering its destruction very difficult where it is once established. The diligent farmer may free his farm from weeds one year, only to find that a shiftless neighbor has raised a crop of Thistles or Dog's Fennel to reseed his farm and necessitate a yearly repetition of this labor. No wonder the farmer becomes discouraged after a few years experience of this sort and soon his fields are as bad or worse than his neighbors.

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PLATE IX.—Sow Thistle. (*Sonchus oleracea*, L)

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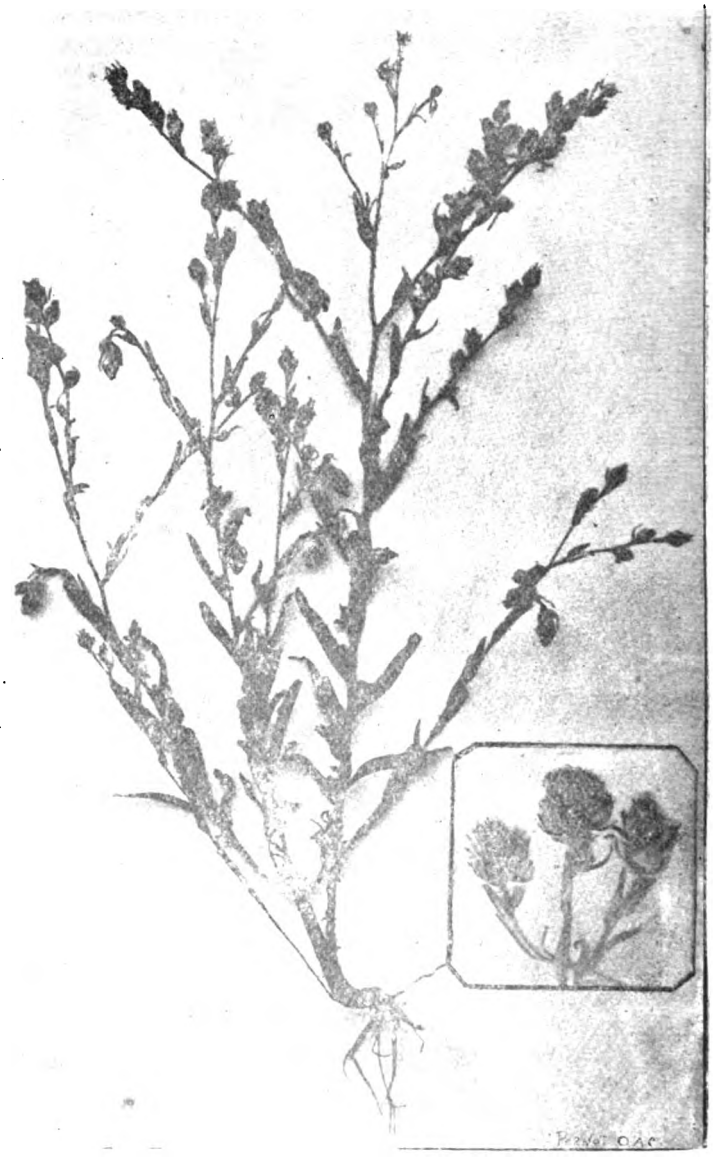


PLATE III,—Tarweed. (*Madia sativa*, Mol.)

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VITALITY OF SEEDS.

There are some weeds whose roots or seeds seem ever in the soil ready to germinate and grow whenever a favorable opportunity offers. The opinion prevalent among some farmers that wheat turns into cheat arose in this way: Chess seeds often remain in the soil several years before germinating, if for any reason the wheat crop failed and chess seeds already in the ground came up the natural though erroneous inference was that the wheat had run wild or turned to chess.

FRUITFULNESS OF WEEDS.

Most weeds are propagated by seed which is produced in great abundance and modified in various ways to aid in the distribution. As an illustration of the fruitfulness of weeds we estimated the number of seeds on a single plant of Moth Mullein (*Verbascum Blattaria*, L.) collected in Linn county. It bore ninety-five flowers and ninety-one capsules, three of these were selected and the seeds carefully counted, they averaged three hundred and thirty seeds apiece. Assuming that the flowers are all fertile and yield in the same proportion we have 61,380 seeds as the product of a single plant and there were several hundred of these plants in the field: What a harvest the owner will reap next year!

GENERAL RULES FOR KILLING WEEDS.

The method of destroying weeds varies with the nature of the plant but some general rules may be given. Annuals, that is plants living only one year, can easily be destroyed by keeping them mowed or by plowing them under. Sometimes the seeds remain in the ground for a long time without germinating, if the conditions are unfavorable, but a little care for a few years in removing all plants before any of the seeds ripen will gradually rid a place of them. Biennials may be destroyed in the same way, but perennials, that is plants living for several years, are more difficult to dispose of, if however they are kept cut close to the ground and not allowed to develop their leaves which have been compared to the lungs of animals they become weakened, the other plants get a start and choke the weeds out. Cutting when in flower will kill many weeds. Cultivation in a dry time and when the plants are growing is most injurious to weeds and beneficial to crops. Avoid the introduction of weeds in manure, or litter, or from weedy surroundings. After a summer crop has

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ripened sow some crop to cover the ground and keep weeds down. Give clean cultivation every few years either with a hoed crop or a fallow. Keep ground well occupied with crops. Keep meadows and roadsides well seeded and plow-land cultivated unless shaded by crops. Weeds are not only unsightly but they occupy valuable space crowding out crops from which they take moisture and nutriment and thus lesson the yield. Remember that "an ounce of prevention is worth a pound of cure" and that "one years seeding is seven years weeding," so always sow pure seed. Unless one can readily distinguish good seed from bad he should purchase his seed only from reliable firms. Good seeds are smooth, shiny, full and heavy, readily sinking in water and popping like corn when placed on a hot stove.

OREGON LAWS FOR EXTIRPATING WEEDS.

As far as we are able to ascertain there is no law in this State requiring the destruction of any weed except the Canada Thistle and the Dagger Cockle-bur. There are, however, several plants that are becoming so troublesome in different parts of the State as to require united efforts for their destruction. We desire to call especial attention to these new weeds that are continually coming into the State and urge that they be destoyed before they become thoroughly established.

An act for the Extirpation of the Canada Thistle:

SECTION 1. It shall be the duty of the Supervisors of the several counties in this State, in addition to the duties hitherto prescribed by law, to cause the destruction, in the manner which to the said supervisor shall seem the most effective, of the weed known as the Canada thistle, where such weed shall be found growing upon the public highways and county roads of this State.

SEC. 2. The road supervisor of each road district in this State shall immediately after this Act takes effect, and from time to time thereafter, ascertain whether or not there is any weed known as the Canada thistle in his road district, and shall as soon as he ascertains that there is any of said weed, notify the county court of his county in writing at a regular session thereof of the existence of said weed, and upon whose land the said weed is growing. As soon as the county court has received said information said court shall appoint a householder in said road district as a commissioner, to hold office for the term of one year, whose duty it shall be to cause the said weed to be extirpated wherever found within said district.

SEC. 3. When the commissioner aforesaid is appointed it shall be his duty to ascertain from the road supervisor of his district the exact location of said weed, and he shall then notify the owner of the land upon which it is growing of its presence thereon, and request said owner to effectually remove said weed from his land; and in case the residence of the owner is unknown or is so far away that he cannot be notified, or, if notified, can not attend to the extirpation of said weed within a reasonable time, then it shall be the duty of the commissioner to notify the occupant of said land and request him to extirpate said weed from said land.

SEC. 4. If such owner or occupant shall fail or refuse to destroy such weed after being notified by the commissioner of the existence of such weed upon his land, then it shall be the duty of said commissioner, and he shall have authority to go upon said land and cause said weed to be extirpated from said land in the manner which to him seems the most effective. The expense of destroying said weed on said land shall be paid upon proper showing made by the commissioner out of the county funds, and shall be and remain a charge upon said lands, to be assessed to said land and collected the same as taxes: *provided*, that the same may be remitted by the county court at any regular session thereo upon the petition of ten resident householders of the precinct where said petitioner resides

SEC. 5. The commissioner shall receive from the county for his services, specified in sections 3 and 4 of this Act, the sum of two dollars per day actually employed.

SEC. 6. If the road supervisor or commissoner mentioned in this act willfully violates

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any of the provisions thereof, he shall be deemed guilty of a misdemeanor, and upon conviction thereof in any justice's court having competent jurisdiction, shall be fined not less than fifty nor more than one hundred dollars for each offence.

Sec. 7. It shall be the duty of all municipal corporations and county authorities in this State to provide for the extermination of said Canada thistle within the limits of such corporation or on the vacant lands within such county, and any city or town corporation within this State neglecting or refusing to comply with the provisions of this section shall be liable to a forfeiture to the State of a sum not less than fifty nor more than five hundred dollars, to be recovered by suit in the name of the State in any court of competent jurisdiction.

Sec. 8. It shall be the duty of the several district attorneys of this State to prosecute all suits brought under the provisions of section 7 within their respective counties, and such attorneys shall be entitled to a fee of twenty-five dollars for every judgment renderd in favor of the State in such suits, and shall be entitled to a fee of ten dollars for every suit bronght under the provisions of this Act when judgment is rendered against the State.

Sec. 9. Inasmuch as there is urgent need for the immediate extirpation of this weed, this Act shall take effect upon its approval by the Governor.

Session Laws of Oregon 1889, pp. 70-72.

An act for the Destruction of the Dagger Cockle-bur:

Sec. 4208. It shall be the duty of the supervisors of the several counties in this state in addition to the duties hitherto prescribed by law, to cause the destruction of in the manner which to said supervisors shall seem most effective, of the weed known as the dagger cockle-bur, where such weed shall be found growing upon the public highways and county roads of this state.

Sec. 4209. The road supervisor shall have the the power to warn out laborers upon the public highways for the extirpation of said weed, as in cases of repairs of such highways.

Sec. 4210. Any road supervisor neglecting to perform his duty under the provisions of this chapter shall be liable to a fine of not more than twenty-five nor less than five dollars, to be recovered to the use of the county before any justice of the peace by suit in the name of the county.

Sec. 4211. The owners or occupants of lands shall carefully extirpate such weed when the same is found growing upon the land of such owner or occupant; and if such owner or occupant shall fail or refuse to destroy such weed after being notified by the road supervisor or any other person of the existance of such weed upon his land, then it shall be the duty of the road supervisor to cause said weed to be destroyed upon said land, and at the expense of the owner thereof, the expense of such labor in destroying such weed to be recovered by suit in the name of the county before any court of competent jurisdiction.

Sec. 4212 It shall be the duty of municipal corporations and county authorities in this state to provide for the extermination of the said dagger cockle-bur within the limits of such corporation, or on the vacant lands within such county, and any city or town corporation within this state neglecting or refusing to comply with the provisions of this section shall be liable to a forfeiture to the state of a sum not less than fifty nor more than five hundred dollars, to be recovered by suit in the name of the state in any court of competent jurisdiction.

Sec. 4213. It shall be the duty of the several district attorneys of this state to prosecute all suits brought under the provisions of section 4212 within their respective counties, and such attorneys shall be entitled to a fee of twenty-five dollars for every judgment rendered in favor of the state in such suits, and shall be entitled to a fee of ten dollars for every suit brought under the provisions of this chapter when judgment is rendered against the state.

Chapter 82 Hill's Annotated laws of the State of Oregon.

It will be noticed by some that in the plants mentioned below the common or English name is followed by another printed in *italics*. This is the scientific or Latin name used by botanists the world over, while the common name changes even in different parts of the state. Thus in the above law one might be uncertain whether "Dagger Cockle-bur" means *Xanthium spinosum*, *L.*, *Gilia squarrosa*, H. & A., or some other plant. All uncertainty would be removed by the use of the Latin name.

CIRCULAR ON WEEDS.

In order to learn more about the most injurious Oregon plants prepared and sent out two thousand circulars setting forth

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briefly the damage annually caused by weedy plants and urging all to co-operate with us by answering the following questions:

Name.....Post Office,.....County,.....

1. What are the worst weeds growing upon your farm and roadsides? Name them in order of badness, beginning with the worst, and in case of doubt as to name or properties send specimens.
2. What is the character of the soil?
3. What means do you take to destroy your weed crop? Do you cut and burn them or do you compost them? With what result?
4. What weedy plants if any do you use for fodder and for what animals? Do you consider them of much value?
5. What new weeds have you noticed on your farm lately? Do they spread rapidly or do much damage?
6. What medicinal or poisonous plants grow on your farm? State some of their properties.
7. Underline all of the following weeds that now grow on your farm. Place a question mark after the name of any plant that you do not know.

Tarweed, *Madia glomerata*, Hk.
Wild Oats, *Avena fatua*, L.
Dog's Fennel or May-weed, *Anthemis Cotula*, DC.
Canada Thistle, *Cnicus arvensis*, Hoffm.
Chess or Cheat-grass, *Bromus secalinus*, L.
Common Brake or Fern, *Pteris aquilina*, L.
Field or Sheep Sorrel, *Rumex Acetosella*, L.,
Bull Thistle, *Cnicus lanceolatus*, Hoffm.
Ribgrass or Narrow-leaved Plantain, *Plantago lanceolata*, L.
Bluebottle, French Pink, Cornbloom, *Centaurea Cyanus*, L.
Ox-eye or White Daisy, *Chrysanthemum Leucanthemum*, L.
Moth Mullein, *Verbascum Blattaria*, L.
Pepper-weed, *Gilia squarrosa*, Hk. and Arn.
Burdock, *Arctium Lappa*, L.
Common Mullein, *Verbasum Thapsus*, L.
Wild Mustard, *Brassica campestris*, L.

We received replies from ninety farmers living in the different counties of the state; from the facts thus obtained and from personal observations we have selected the following plants as among the worst Oregon weeds. Scientific readers who desire technical description of these plants should consult Gray's Manual or Watson's Botany of California as the following being popular descriptions necessarily loose some of their scientific accuracy.

LARKSPUR. (*Delphinium, sp.*)

The Larkspurs are perennial herbs with palmately lobed leaves. Sepals five, very irregular, upper one produced below into a long spur. Petals four, irregular, the two upper ones spured at base. This plant, found in woods and damp pastures, has been thought to be poisonous to stock. Dr. P. H. Irish, formerly the Station chemist, experimented with the common blue larkspur (*D. exaltatum, Ait*). as follows:

"Two well developed, healthy yearling steers were bought for the experiments, which were to discover whether the plants under examination were injurious, and if so to note the symptoms developed. Twenty-four specimens of larkspur were taken, the tops chopped and mixed with an equal amount of clover grass fed to one, the roots prepared in a similar way, were fed to the other animal, in both cases without any apparent ill effect. As great a quantity of the plant was fed to each as cattle under ordinary

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PLATE IV.—May-Weed, Dog's Fennel. (*Anthemis Cotula*, DC.

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PLATE XI.—Mullein. (*Verbascum Thapsus*, L.)

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circumstances would be liable to obtain in the pasture. The larkspur used was mostly in full bloom and the individuals were chiefly good sized plants. White larkspur was next tried. Thirty plants, well developed, in full flower, were fed in a manner similar to that noted with the blue larkspur. No effect noted." (Bulletin No 3, Oregon Experiment Station, October, 1889, p. 25).

ACONITE, MONKSHOOD. (*Aconitum Fischeri.* Reich.)

A perennial herb whose general appearance is similar to that of the above. Leaves palmately cleft, the divisions broadly wedged-shaped and cut-toothed. Sepals five, irregular, the upper sepals being arched into a hood which conceals the spur-like blades of the upper pair of petals. Petals five, the three lower minute, the two upper on long claws. The terminal spikes of dark blue flowers make a handsome appearance. Very poisonous but fortunately quite rare in this state. The spindle-shaped root has been mistaken for Horse-radish (*Nasturtium*) with fatal results.

WILD MUSTARD, WILD TURNIP. (*Brassica campestris* L.)

Root annual or sometimes biennial. Stem round, smooth, much branched, two to four feet high. Lower leaves of a blue-ish-green color, pinnately divided and with a large terminal lobe; upper leaves lanceolate with a broad clasping, eared base. Flowers bright yellow, sepals and petals four, the latter about half an inch long, stamens six, two shorter than the others, anthers long. Pods roundish or somewhat four-sided, two inches or more long and one-sixth of an inch wide, on spreading pedicels, the stout beak about two-thirds of an inch long,

The mustard has escaped from cultivation, degenerated, and become a great nuisance in cultivated fields and waste places. It does much damage in grain fields by choking out the grain.

Where once established it is difficult to exterminate as the seeds retain their vitality for a long time. Sheep are said to like the foliage and by their close nibbling will soon kill the plants. Cutting when in bloom will also kill it and a few years of clean culture eradicates it.

WINTER CRESS, YELLOW ROCKET. (*Barbarea vulgaris*, R. Br.)

This plant grows in the moist rich soil of fields, and along roadsides, resembling the above somewhat in appearance. Root perennial. Smooth, erect, branching, one to three feet high. Lower leaves lyrate with a large rounded terminal lobe, and one

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to five pairs of lateral lobes, upper leaves obovate more or less pinnatifid at base. Flowers yellow, petals a quarter inch long. Pods erect about an inch long, somewhat angled, and beaked with the rather slender style. It may be destroyed in same manner as the Mustard.

SHEPHERD'S PURSE. (*Capsella Bursa-pastoris*, Mœnch.)

A common low-branching annual, found in neglected ground along roadsides and in gardens where it grows to the height of a foot or more. Leaves pinnatifid, growing mainly from the base of the stem and spread flat on the ground, stem leaves lanceolate, arrow-shaped, sessile. Flowers very small, white, at first crowded near the ends of the branches, at length forming a long leafless raceme. Pods on slender stalks, purse-shaped or flat triangular, a quarter of an inch long, broadest above and notched at the apex producing a large number of seeds. Does not root deeply and is readily destroyed by frequent hoeing, or good cultivation which induces a vigorous growth of more useful plants.

ALFILARIA, PIN-GRASS. (*Erodium cicutarium*, L. Her.)

This is a valuable and nutritious forage plant belonging to the Geranium family. Root annual. Stems hairy, much branched, spreading, seldom more than two feet high. Leaves pinnately divided, three to five inches long, consisting of about six pairs of sessile leaflets with narrow, acute lobes, stipules acute. Flowers small, rose-colored, in a four to eight flowered umbel borne on a peduncle longer than the leaves and rising from their axils. Sepals and petals five, stamens ten. Styles twisting spirally in fruit, bearded inside. The juicy leaves and stems are said by Prof. Brewer to give an excellent flavor to milk and butter. [See Plate II.

POISON OAK. (*Rhus diversiloba*, T. & G.)

Poison Oak is an erect slender shrub very abundant in many parts of the state. It grows from three to eight feet high and sometimes becomes stouter climbing by rootlets. Leaflets ovate or elliptical about two inches long, the three lobes and the teeth obtuse. Flowers whitish, one-sixth of an inch long, in loose axillary, peduncled panicles. Fruit white, one-fourth of an inch in diameter, compressed.

The Poison Ivy (*R. Toxicodendron*, L.) resembles this but differs in its sharply toothed, acuminate leaflets, and nearly

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sessile panicles which are more dense in fruit. Both species are poisonous, causing a severe cutaneous eruption accompanied by an intense smarting or itching.

SWEET OR TREE CLOVER. (*Melilotus alba*, L.)

An erect, annual, or biennial herb growing from two to four feet high. Leaves pinnately trifoliate; leaflets obovate, toothed and truncate, fragrant in drying. Flowers small, white, borne on slender pedicels in spike-like racemes. Pods ovoid, leathery and wrinkled. The seeds resemble those of Alfalfa with which it is sometimes planted. It has been recommended as a honey plant and for soiling, but it is seldom used as a forage plant as cattle do not eat it when they can get other food.

BUR-CLOVER. (*Medicago denticulata*, Willd.)

This is a smooth annual belonging like the above to the Bean Family (*Leguminosae*), which like its near relative Alfalfa (*M. sativa*, L.), is valuable as a forage plant. Stem prostrate or ascending; Leaves pinnately trifoliate, leaflets obcordate, toothed above. Flowers small, yellow, usually three to eight, in a small cluster. Pods compressed, spiral, strongly net-veined; the thin keeled margin armed with a double row of hooked prickles which adhere to the wool of sheep causing much damage. It fruits abundantly and the pods, which remain good until the winter rains, are eaten greedily by sheep and cattle.

WILD GOURD, BIG ROOT. (*Megarrhiza Oregona*, Torr.)

Stems elongated, climbing from large, spindle-shaped, perennial roots. Leaves cordate, five to seven lobed; tendrils two to five cleft. Flowers small, white, in early spring, monœcious the sterile in racemes, the fertile pedicelled and solitary growing from the same axis. Calyx bell-shaped, teeth very small. Corolla rotate, deeply five to seven lobed with papillose segments. The young fruit with soft spines, matured fruit unarmed; seeds an inch in diameter and half as thick. The most effective method of destroying Man-in-the-ground is to make a deep hole in the roots with a crowbar and fill it with coal oil which causes them to rot. Strong brine has been used in the same way but is not as effective.

The sunflower family (*Compositæ*) contains many weeds which we are compelled to omit for want of space. The general

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rules for destroying weeds given on page 5 will prove effective, as will also the methods given for Canada thistle on page 14.

SPINY OR DAGGER COCKLE-BUR. (*Xanthium spinosum*, L.)

A coarse annual found in farm yards and in waste places along roadsides, etc. Stems, two to four feet high, much branched, bearing long slender yellow triple spines, an inch long and very sharp, at the base of the alternate lance-ovate leaves. The leaves are white-downy beneath and attenuate to both ends with a short petiole.

Heads monœcious, pistillate flowers enclosed in a bur-like, ovoid, closed, two-celled involucre armed all over with strongly hook-tipped prickles which cause great annoyance in the fleeces of sheep. Clean culture with a hoed crop, or seeding with clover, will with frequent mowing keep the plant subdued.

TARWEED. (*Madia sativa*, Mol. var. *congesta*, T. & G.)

A viscid, hirsute, glandular, heavy scented annual two to three feet high. Heads sessile, many flowered, in crowded clusters opening in early morning and in cloudy weather. Ray flowers five to twelve, disk flowers same number. Akenes, narrow, angled, smooth, and destituteof pappus. Leaves lanceolate, entire, the upper alternate. The whole plant is covered with a tar-like secretion which adheres to clothing etc., thus aiding in distributing the plant. This and the Dog's Fennel are a curse to western Oregon and their destruction should be required by law. We can give only general remedies such as underdraining which in "white land" has proven of much value in destroying this vile weed. Keeping the plants cut down and burning over the infested fields is also good. The seeds will stand a hot fire and often remain in the soil a long time before germinating.

A parasitic fungus (probably *Coleosporium Madiæ*, Cke., though it is not given in Farlow's Host. Index as occuring on this plant) was very abundant in the fall of 1891 and proved quite destructive. [See plate III.

MAY-WEED, DOG'S FENNEL. (*Anthemis Cotula*, DC.)

Root annual. Stem one to two feet high, erect and simple below or with spreading branches at the base. Leaves numerous, alternate, one or two inches long, twice or thrice pinnate, the fine segments giving them a feathery appearance. Heads radiate, terminating the long slender branches; disk yellow, globular ⅓

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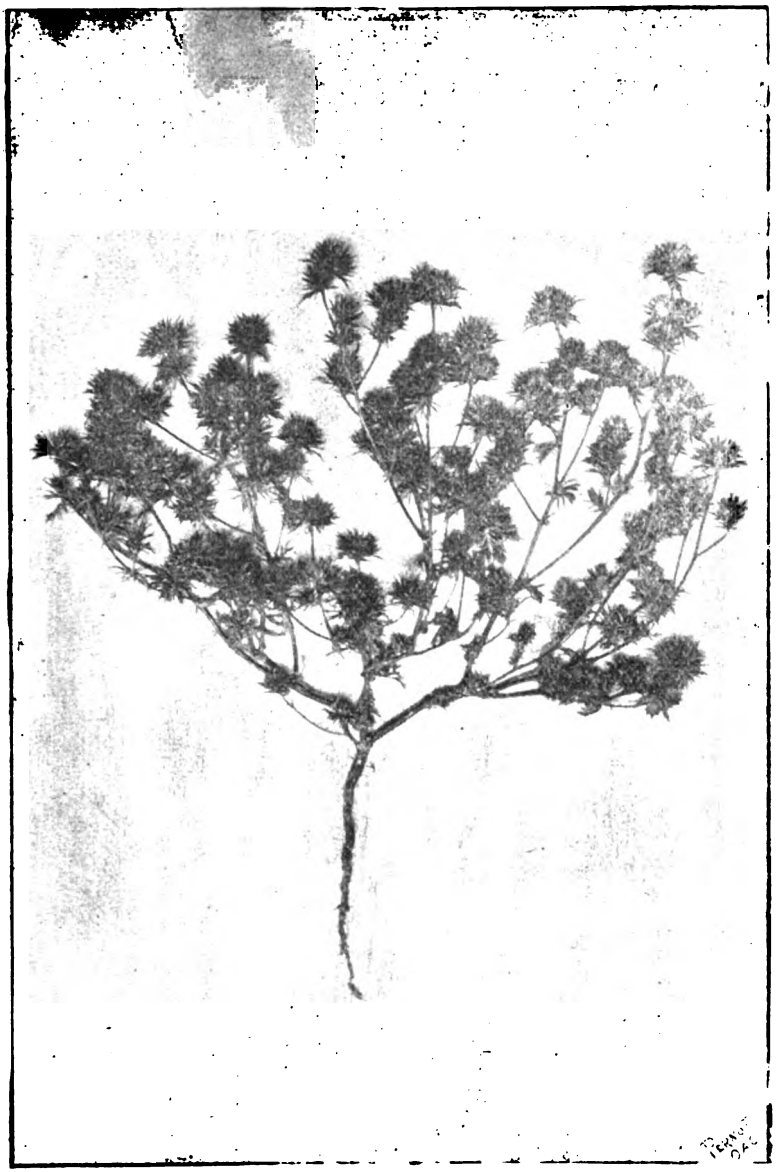


PLATE X.—Pepper-weed. (*Gilia squarrosa*, H. & A.)

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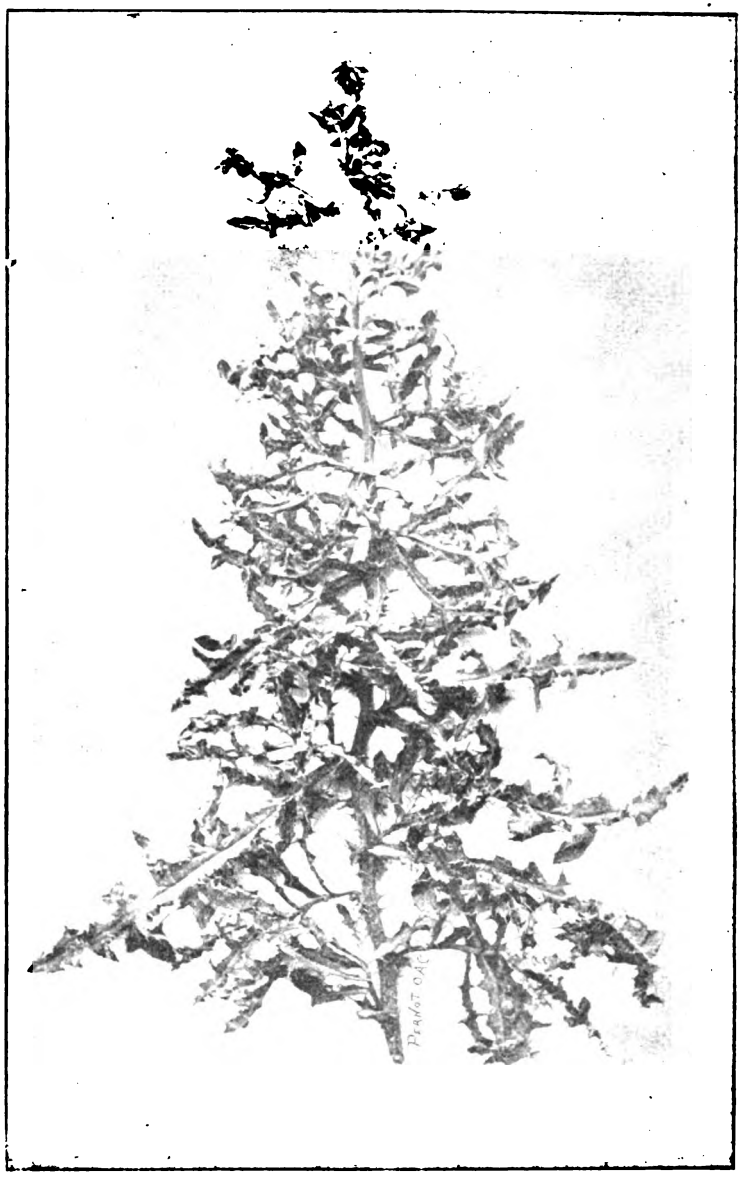


PLATE VI.—Canada Thistle. (*Cnicus arvensis*, Hoffm.)

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inch in diameter. Disk flowers fertile, the upper with chaffy bracts, ray flowers neutral, white.

This strong scented and bitter tasting weed is now naturalized in pastures and along roadsides, delighting in hard dry soils. This weed though one of the most abundant in the State may be readily destroyed by mowing, when it is coming into bloom, and burning the tops. If none are permitted to seed the land will soon be freed of this pest. [See plate IV.

WHITE-WEED, OX-EYE-DAISY. (*Chrysanthemum Leucanthemum* L.)

A few branched perennial, one to two feet high, stem sparingly covered with narrow coarsely-toothed, obovate leaves, the upper sessile with a clasping fringed base, the lower ones petioled.

The stem and branches are each terminated with a single head of flowers about an inch and a half in diameter. Within the thin scaled involucre are two kinds of flowers—an outer row of flat, showy, white ray florets and a central cluster of short, tubular, yellow disk flowers—both of which are fertile.

This though a native of Europe is widely spread over the United States, in some cases it has escaped from flower gardens, in others it was introduced in grass or clover seed. It spreads rapidly both by the creeping root-stocks and by the abundantly produced seed.

Its history in Benton Co., is as follows: In 1879 or 1880 Mrs. Fridley sent east for Margarite seed which she sowed in her garden. In three years the plant had run wild and become thoroughly established; it spread rapidly and the gain each year was four or five rods. It traveled toward the east and south faster than to the west and north because the prevailing winds are from the west and north.

If the land is kept fertile, seeding heavily with pure grass and clover seed will keep the daisies down so that the few remaining plants may be readily destroyed. The close grazing of sheep will soon exterminate it. In wheat land the summer fallow, plowing twice during the season is said to be effective. [See plate V.

CANADA THISTLE. (*Cnicus arvensis*, Hoffm.)

This plant differs from the common Bull Thistle (*C. lanceolatus*, Hoffm.,) for which it is often mistaken, in its slenderer stem and branches, in the thin, narrow, curled and more deeply cut leaves, less rigid prickles and smaller flower heads which are

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about half an inch in diameter. It is more difficult to destroy than the common thistle as it is a perennial spreading by long underground stems, which penetrate deeply into the soil, often below the reach of the plow.

These rhizomes extend horizontally in all directions and being furnished with buds send branches to the surface where the first year radical leaves are developed and the second year aerial stems which bear flowers and seed. The second autumn these die down to the ground but in the spring the rhizomes again send up numerous branches which soon cover the ground, the plants spreading with suprising rapidity from year to year.

This "Cursed thistle" is also propagated by seeds which supported by the downy pappus are often carried long distances by the wind. Like most of our troublesome weeds it was introduced from Europe and has become permanently established in this country. It has been reported from the following localities in Oregon:

Benton County, Moses Craig, Corvallis.
Clackamas County, L. P. Williams, Oregon City.
Curry County, E. A. Thorhaven, Langlois.
Harney County, D. Overton, Drewsey.
Lane County, S. C. Sparks, Thurston.
Marion County, Eugene Brown, Silverton.
Sherman County, Isabel Reed, Moro.
Umatilla County, S. K. Coe, Milton.
Washington County, K. Sattler, Buxton.

EUGENE BROWN says: "It seems the thistle is very abundant in Marion county. The first start in this neighborhood was about twenty years ago when a man bought a new separator from the East. The spot on which the machine was set up and first run was found to have a number of fine Canada thistle plants the next year. A neighbor who had a number of patches on his place last season—supposed to have been bought in seed grain—tried my plan of salting them and exterminated about a quarter of an acre."

L. P. WILLIAMS says; "Canada thistle has been growing on this farm seven years, it has never been allowed to seed but has spread from the roots. Three years ago it occupied ten square feet now it is spread thinly over twenty square feet. After repeated trials to down it I pronounce it impossible unless each root is dug out carefully. I have had the best success in putting it back by letting it bloom, cutting it two inches under ground then salting and covering with dirt, under this treatment it did not show itself until late the next spring. I always bring every fragment of thistles cut to the house and burn in fireplace."

HOW TO DESTROY CANADA THISTLES.

Frequent deep plowing will, in shallow dry soils nearly always destroy the thistle but in light, rich, moist soils this usually fails. Wherever a dense sod can be formed seeding will be found the easiest means of destruction; though not so rapid as plowing,

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hoeing, salting, or burning where these means are available. On rich bottom lands or in ground filled with stumps, a grass sod will be found the best destroyer. If the land is not rich enough to form a good sod manure it. Mowing when the thistle is *coming into* bloom does not destroy the plant though it checks its growth. Applying kerosene oil to the roots after cutting is effectual and practicable in small patches. In stony ground the scythe, salt, and sheep will be found good destroying agents. If the thistles are in fence-rows move the fence and plow. One object of thorough cultivation is that all thistle seeds may germinate and be destroyed at once and not lie dormant in the ground coming up a few at a time to reseed the field.

The seeds resist everything but a hot fire, and Dr. Millspaugh says: "The larger the fire, the better, it would be more profitable to use a barn or two for fuel than to allow this weed to grow and mature seed." *Caution.* Plowing and stirring the soil when infested with this weed, unless thoroughly done, only multiplies them, so permit no leaves or roots to remain and burn the plant immediately after cutting. [See plate VI.

COMMON OR BULL THISTLE. (*Cnicus lanceolatus*, Hoffm.)

This is a biennial, producing the first year simply a tuft of large spiny leaves spread out flat upon the ground but the second year it sends up a stout, erect branched stalk two to four feet high. The pinnatifid leaves are about five inches long and the lobes are provided with sharp, stiff spines. It may be distinguished from the Canada thistle by the larger flower heads, one to one and a half inches in diameter, and the sessile leaves cobwebby beneath with margins running down the stem as ragged wings. This objectionable weed, which delights in a rich soil, is common in pastures and along roadsides. It should be carefully destroyed as the seeds supported by the spreading pappus are carried long distances through the air scattering the plant far and wide. The Bull Thistle is easily killed by keeping it cut just below the surface of the ground as the plant is sure to soon die of exhaustion. Any of the methods suggested for exterminating the Canada thistle will destroy this. [See plate VII.

BURDOCK. (*Arctium Lappa*, L.)

This is a coarse, large leaved, biennial found in waste places and in rich soil about dwellings. It has a thick branching stem

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two to four feet high, with heart shaped leaves, the lowest on long stout petioles, the upper nearly sessile. Flower heads nearly round, about an inch thick and of a purple color, occuring in small clusters at the ends of the branches. The floral scales are abruptly tipped with an awl shaped hook by which the "burs" adhere to the wool of sheep or the hair of cattle.

It is easily destroyed by cutting off the root a few inches below the surface of the ground, or by mowing when in bloom and burning the tops. [See plate VIII.

FRENCH PINK, STAR-THISTLE. (*Centaurea Cyanus*, L.)

Stem branched two to four feet high. Leaves alternate, lance-linear, sessile, entire. Heads large, solitary, many-flowered; the neutral marginal florets blue, enlarged and conspicuous, the central ones purple, perfect. Scales of the globular involucre fringe margined. Pappus shorter than the oblong compressed akene.

A troublesome weed in grain fields becoming common in Western Oregon. As it is an annual it may be destroyed by keeping it cut and not permitting it to ripen seed.

SOW-THISTLE. (*Sonchus oleracea*, L.)

A smooth, leafy-stemmed annual, two to three feet high, of coarse appearance, with paniculate, many-flowered heads of yellow flowers. Leaves runcinate-pinnatifid, with short, soft. spiny teeth clasping by a heart-shaped base. Involucre thickened at base, scales imbricated. Pappus of copious white capillary bristles, united at base. Akenes compressed, scabrous, many ribbed but not beaked. Waste ground and in gardens, easily destroyed by cultivation. [See Plate IX.

PEPPER-WEED, SKUNK-WEED. (*Gilia squarrosa*, H. & A.)

A rigid, stout, much branched annual, very glandular and pungent, smelling like its namesake and causing a flow of tears when broken by threshing. Leaves twice pinnatifid, the upper bracts spinescent. Corolla blue, slender, tubular, half an inch long, shorter than the entire calyx lobes. Abundant everywhere. Keep it cut down. [See Plate X.

DODDER ON ALFALFA.

This Dodder (*Cuscuta racemosa*, Mart. var. *Chiliana* Eng.) is parasitic on Alfalfa or Lucerne (*Medicago sativa*, L.) The Dodders are leafless annual herbs with thread-like yellowish stems rising from the ground and becoming parasitic on the bark of

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PLATE XX.—Brake. (*Pteris aquilina*, L.)

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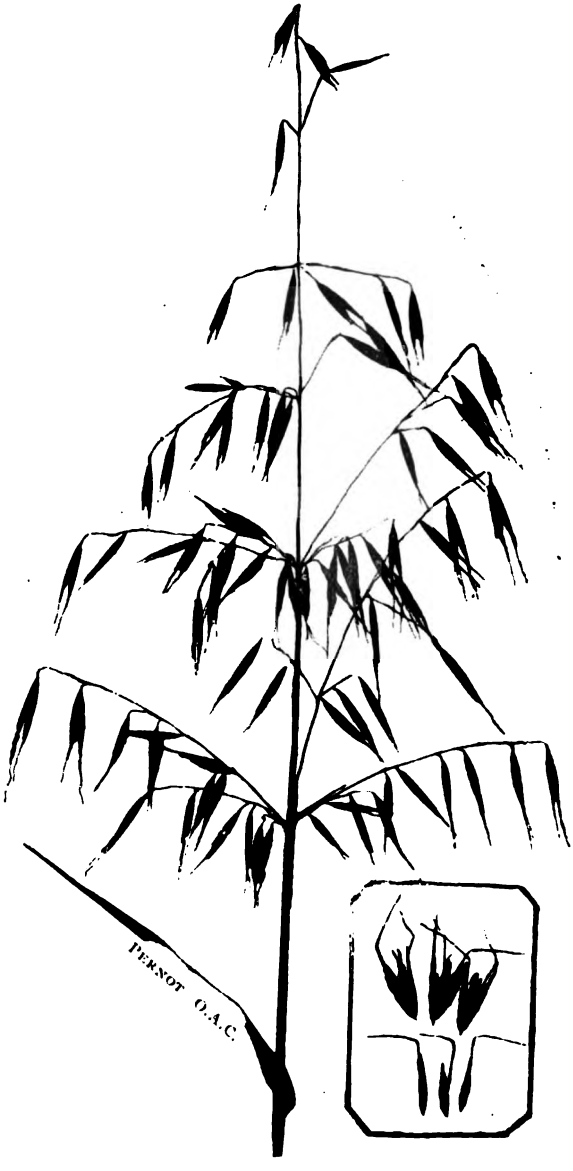


PLATE XVII.—Wild Oats. (*Avena fatua*. L.)

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herbs and shrubs around which they twine and to which they adhere by means of suckers through which they draw juices from the host plant. The lower part of the stem then dies, but the threads develop rapidly until a circular patch of Alfalfa is covered by the Dodder and becomes so weakened that it turns brown and dies.

REMEDIES: *First*, plant only pure seed, dodder seeds are similar to those of Alfalfa but can be separated by careful screening. *Second*, if the meadow is but slightly infested, mow and destroy the infested patches as soon as seen, and if no patches are allowed to seed the Alfalfa will be saved. If, however, the meadow is full of dodder plow up the Alfalfa and plant other crops for a few years when all the Dodder seeds will have germinated and died for want of a suitable host on which to feed. *Third*, never save an infested crop for seed.

MULLEIN. (*Verbascum Thapsus*, L.)

A tall, woolly, biennial herb with alternate, decurrent leaves. Stems erect, unbranched, three to six feet high. Leaves oval-lanceolate, entire, six to twelve inches long. Flowers bracteate, bright yellow, in dense terminal cylindrical spikes. Plate XI shows a specimen collected by the author in Benton county.

The Moth Mullein (*V. Blattaria*, L.) differs from the above in the smooth, slender stem and serrate not decurrent leaves. Lower leaves petiolate often pinnatifid, the upper sessile clasping. Flowers white or yellow in a long raceme, pedicels about an inch long. Filaments bearded. Both these plants produce a vast number of seeds and should be carefully destroyed by digging up the roots when young.

NARROW-LEAVED OR ENGLISH PLANTAIN. (*Plantago lanceolata* L.)

A stemless perennial, with hairy, stongly ribbed leaves four to eight inches long and tapering towards both ends. Scapes several, one to two feet high, spike one to two inches long, nearly cylindric, dense-flowered. Seeds oblong, convex on one side concave on the other, shining, brown or amber-colored.

This plant, though a native of Europe, is now found throughout the entire country in pastures, meadows and lawns. Some consider it a good forage plant for sheep and cattle. The seed is easily distinguished from that of grasses and other forage plants, which should be carefully examined before planting. If the weed is once established, plow it under and cultivate the soil for a few

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years. Small patches may be destroyed by cutting off the plant a few inches below the surface of the ground with a sharp hoe. A heavy crop of clover or grass would perhaps choke it down. [See plate XII.

YELLOW OR CURLED DOCK. (*Rumex crispus*, L.)

Coarse perennial herbs with an acid juice. Stems smooth, two to four feet high, from a fusiform root. Leaves narrowly lanceolate, acuminate, wavy-curled, about six inches long on short petioles. Panicles open with numerous dense whorls of small green perfect flowers. Akenes a line long, three angled, wingless. It is best destroyed by pulling up the roots when the ground is wet. [See Plate XIII.

FIELD OR SHEEP SORREL, RED TOP. (*Rumex Acetosella*, L.)

Sheep sorrel is a dicœcious plant which spreads rapidly by perennial running rootstocks. The stems are about a foot high, slender, erect and somewhat angular. Foliage very acid, but pleasant to the taste. Lower leaves are arrow-shaped and long staked, upper ones sessile. Flowers small in red or purplish racemes. Fruit three angled, wingless. As it grows most abundantly on poor thin soils, improving the land by the application of time and fertilizers is the best method of expelling it and with good cultivation the growth of other plants will soon crowd it out. It may also be subdued by keeping the infested land plowed for a short time. [See plate XIV.

PIGWEED, CARLESS WEED. (*Amarantus retroflexus*, L.)

A stout, erect annual two to four feet high with dull green, ovate, acuminate, long petioled, alternate leaves. Flowers minute, green, in thick, erect, scarcely spreading crowded terminal spikes. Bracts lanceolate, pointed, twice the length of the calyx. Grows in waste places and in gardens as does the following, pulling them up when young is easy and effective. [See plate XV.

PIGWEED, LAMB'S QUARTERS. (*Chenopodium album*, L.)

Root annual. Stem erect, branched, striate, two to four feet high. Leaves, rhombic-ovate, one to three inches long; lower dentate, upper lanceolate. Panicle strict or somewhat spreading. Flowers apetalous, densely clustered in close spikes. Whole plant mealy. [See plate XVI.

WILD OATS. (*Avena fatua*, L.)

This is supposed, by some, to be the original of the cultivated

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oat (*A. sativa*, L.) which it closely resembles and which is said to readily degenerate into this. Though an annual it will effectually run out any crop and take entire possession of the soil. It ripens early and shells easily, the kernel when ripe is nearly black and attaches itself to clothing, grain bags, etc. The cleaned grain weighs from twelve to eighteen pounds per bushel and is sometimes ground as a food for stock. The lower palet [chaff] is rough and covered with long brownish hairs. The long, rigid, bent awn is very sensitive to changes of moisture and by its twisting readily burys the seed in damp soil. The wild oat is very abundant in fields all over the state and is sometimes sown for fodder; it is said to make a fair quality of hay for horses and cattle if cut early. Sow only pure seed.

Plow the soil well in the spring making a good seed bed which will induce an early crop of wild oats, when they are four or five inches high plow under and repeat this process of turning under, pasturing with sheep or pulverizing with a spring tooth harrow as long as the plants come up; thus the seeds already in the soil will germinate in one or two seasons instead of coming up a few at a time; if the work is carefully done and no plants permitted to produce seed the ground will be free in a few years. This is a tedious process but there is no royal way to kill the wild oat, unless it be seeding down the land for three or four years. [See plate XVII.

J. P. Taylor of Cottage Grove, Lane Co., says: "I have tried mowing, raking up and hauling wild oats off the land with good results; turning in sheep to eat the missed stalks and heads before they get dry and to keep the after growth from going to seed. The ground is as effectually cleaned as by fallow plowing but can not be put in as early in the fall."

CHESS OR CHEAT. (*Bromus secalinus*, L.)

Chess is a coarse annual grass, with large spikelets, which when properly cured makes excellent hay and large quantities are annually saved for this purpose in some parts of the state. Culm or straw three to four feet high. Leaves six to twelve inches long, narrow, earless, rough and hairy on upper surface, sheath entire. Panicle spreading, spikelets oblong-ovate, turgid, smooth. Glume longer than the palet, short awned. This plant has occasioned considerable discussion because under certain conditions a large amount of cheat appears in wheat fields where there has been none for a long time previous, causing the idea that the wheat had turned to chess, which is not so. Sow only pure seed and keep the grass cut. [See plate XVIII.

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COUCH, QUICK OR QUACK GRASS. (*Agropyrum repens*, L.)

A perennial grass with white, jointed, creeping, underground stems which interweave forming a stiff sod. Culm two feet high, smooth. Leaves rough, four to ten inches long, flat and narrow. Spikelets four to eight flowered, awn shorter than the flower. Very troublesome in cultivated ground because of the vitality of the rhizomes and seeds. The best remedy is to dig or plow up the rhizomes and burn or feed them to cattle. [See plate XIX.

COMMON BRAKE OR FERN. (*Pteris aquilina*, L.)

Rootstock blackish, cord-like, creeping widely underground. Frond dull green, two to three feet wide, three-branched at the summit of an erect, stout stalk one to four feet high. Abundant all over the state forming thickets four to seven feet high and several acres in extent. Stipes not articulated to the rootstock. Branches of the frond widely spreading, twice pinnate ; pinnules oblong lanceolate; the upper undivided, the lower pinnatifid with obtuse lobes. Spores in a continuous slender line occupying the entire margin of the fertile frond and covered by its reflexed edge. There are two forms known as the Big Fern and the Little Fern, the former attains a large size in the foot-hills while the latter grows in the valleys, where it causes much damage by crowding out the crops. Some have recommended cutting it for hay but the dust-like spores are apt to cause indigestion and symptoms in horses similar to those of "Blind-Staggers." Good thorough plowing and the spring-tooth harrow will soon destroy it. [See plate XX.

ACKNOWLEDGMENTS.

In preparing this bulletin we had to depend in a great measure upon our correspondents for information and we take this opportunity to thank those who have aided the Station by sending specimens of plants growing in their vicinity and answering questions regarding their flora. It is through such friendly co-operation in Station work that the best results can be accomplished, as it is impossible for the Botanist to individually visit all portions of the State and make a study of the noxious weeds, forestry, injurious fungi, etc., without neglecting his classes at the College. When you find a weed or fungus that is liable to become injurious, or a plant that may prove valuable for forage, write to the Station about it and we will help you all we can.

For much of the information in this bulletin we are indebted to the Manuals of Botany, to Darlington's American Weeds, to

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our circulars, and to the Bulletins of various Experiment Stations. We have selected and placed in an accessible form as much as our limited space permitted of what is now known regarding Oregon weeds. All the work was done during the rainy season on an unfamiliar flora, which accounts for the absence of many weedy plants, some of which, may appear in a future bulletin.

I desire to express my obligations to E. F. Pernot, of our Department of Photo-engraving, who has spared no effort to make the half-tone engravings perfect under existing conditions. Our thanks are due to Dr. Geo. Vasey, Botanist of the Department of Agriculture for assistance in procuring the electro-types used in this bulletin and to Geo. Marx, chief of Division of Illustrations, for making them.

How to send Plants for Identification.

Remember that the Station was established for your benefit and if at any time you desire information concerning plants growing on your farm, or along the roadsides, or about any plant disease, we will be glad to answer your questions as fully as possible. Questions about plants should be accompanied by specimens, so we may know just what plant is meant. Fragmentary or imperfect specimens are so often sent to botanists for identification that it is necessary to state here what is needed to correctly determine a plant.

The specimens should be complete, that is, they should include the flowers, fruit, leaves and if herbaceous a portion of the root; often the root-leaves are different from the stem-leaves, so both should be sent. Of woody plants a shoot six or eight inches long bearing leaves and flowers and accompanied by the fruit, if possible, will be sufficient. Specimens may be preserved by placing them under pressure between sheets of newspaper immediately after gathering, changing the papers every day for four or five days, after which they will keep indefinitely. All specimens should represent the typical form except when the object is to show some abnormal growth. Number the specimens, wrapping each species separately in old newspapers, and send in an unsealed package with your name and address, preceeded by the word from, plainly written on the outside. The postage is one cent an ounce which must be fully prepaid or the package will not be forwarded. In the accompaning letter state the date and place of collection and whether the plant is considered medicinal, poisonous or weedy, with any other information you consider of interest.

Address all communications relating to plants to

BOTANIST, EXPERIMENT STATION,
Corvallis, Oregon.

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PLATE V.—White-weed. (*Chrysanthemum Leucanthemum.*)

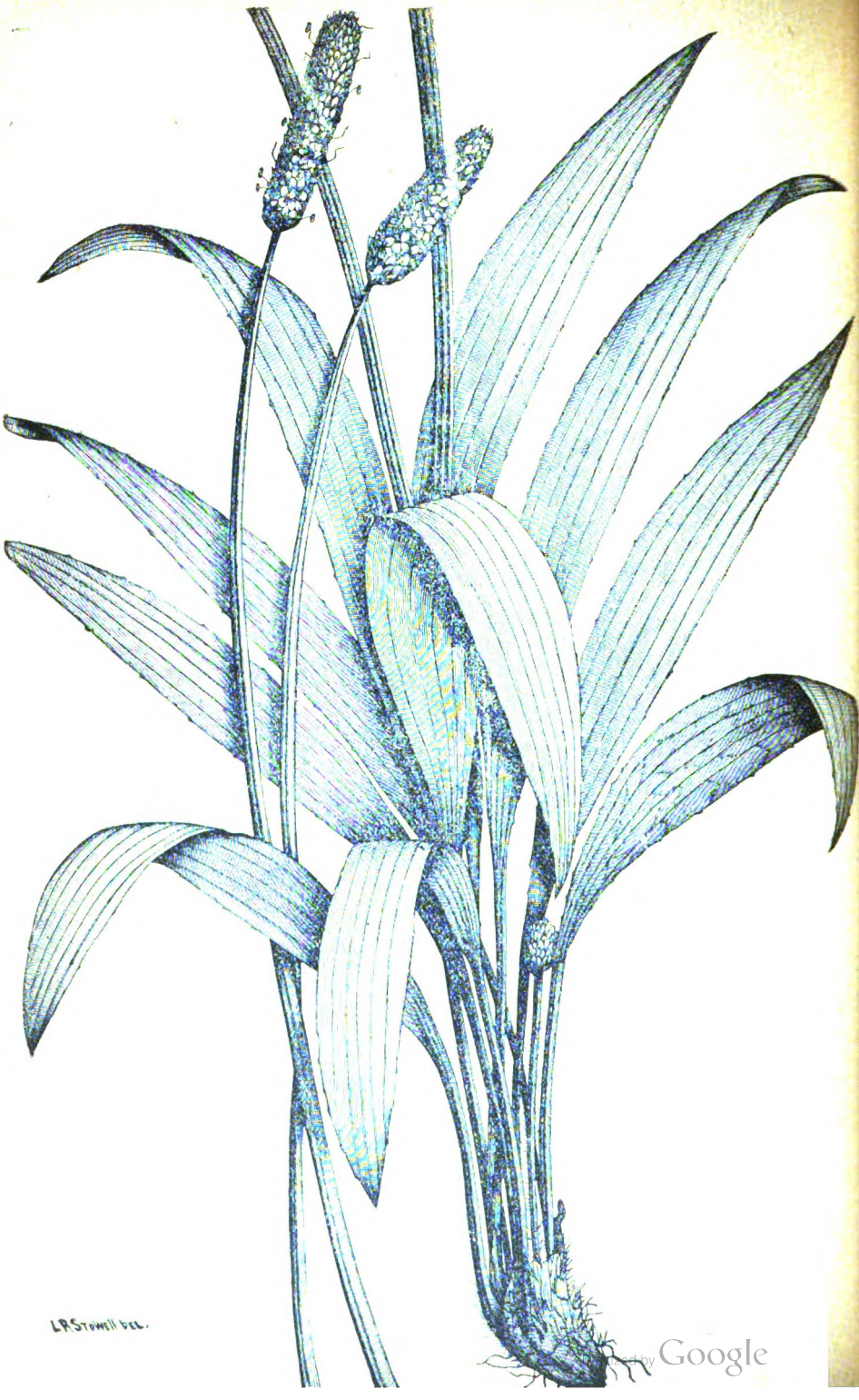
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PLATE XIII.—Yellow or Curled Dock. (*Rumex crispus.*)

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PLATE XVI.—Pigweed. (*Chenopodium album.*)

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RX.DEL.

PLATE XIX.—Couch or Quack Grass (*Agropyrum repens*).

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Oregon Agricultural Experiment Station.

Bulletin No. 20. September, 1892.

AGRICULTURE.

Experiments in Pig Feeding.

H. T. FRENCH,
Agriculturist.

C. D. THOMPSON,
Foreman of Farm.

The Bulletins of this Station are sent free of cost to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE.
H. R. CLARK, Manager,
CORVALLIS, OREGON:
1892.

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THE SUGAR BEET IN OREGON.

By G. W. SHAW, A. M.

In accordance with the plan set forth in Bulletin No. 17, published by this Station in February, 1892, experiments as to the possibility of raising beets for the manufacture of sugar in Oregon have been continued during the past year, and the results, together with other points of interest and importance, are set forth in this bulletin.

The reasons for undertaking the investigations may be stated as follows: The United States consumes annually about 2,000,000 tons of sugar, and the demand is constantly increasing. At present the American people are consuming annually 59 lbs per capita of imported sugar and only 9 lbs per capita of American sugar. To pay for this imported sugar our country has sent to Europe during the last few years about $100,000,000 annually, and this has been done notwithstanding there are areas within the United States as well, if not better, adapted to sugar production than any in Europe. The Federal government, recognizing that we should be independent of Europe so far as possible and the more to encourage home production, on Oct. 1, 1890 abolished the duty on sugar and in lieu thereof offered a bounty of two cents per pound for all domestic sugar testing 90° or more (1½ cts for all testing between 80° and 90°) produced until July 1, 1905. If this country produced her own sugar under this law there would be a bounty of $50,000,000, paid to those engaged in the business in addition to saving to the nation the $100,000,000, now sent to foreign countries to satisfy the sweet tastes of the American people. This would certainly go some distance in satisfying the cry of many farmers for "more money".

The Experiment Stations of many States have been investigating this subject for the past few years and many thousand analyses of American raised beets have been made and there is no longer any doubt but that there are large areas in this country adapted to sugar beet culture. California, Utah, and Nebraska are already reaping the reward of the government bounty and the benefits of home production, and companies are being formed in other states where the conditions seem to be favorable. During the year ending June 3rd, 1892, the government paid for the production of beet sugar the following bounties, California, $163,511; Nebraska, $54,690; Utah, $21,898.

The question comes forcibly to us, can Oregon stand in the line of sugar

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producing states? Can she not reap the rewards of this bounty? One of the heaviest sugar dealers in Portland estimates that that city alone consumes and distributes over 25,000,000 pounds of sugar per annum. In view of what has been said it certainly is well for us to ask why not keep a portion or all of the money paid for this sugar at home and also receive the benefit of the federal bounty, gaining also the other advantages to be derived from this culture, such as building up prosperous communities around the factory, giving better market for other home productions, and encouraging the farmer to adopt scientific methods of cultivation. This manner of work would of a necessity extend to other industries until its influence would be felt in all lines of agricultural pursuits.

If the soil and climate of Oregon are favorable to the production of good sugar beets then there is a new and profitable industry possible for our farmers and capitalists, and according to Mr. Paddock in his speech before the U. S. Senate, the beet sugar industry is more important than any twenty others in this country. It was to seek an answer to this question that the experiments were conducted.

The report of the investigations of 1891, which was published in February of last year, contained a full account of the relation of Oregon's climate to this culture, but since the edition of the bulletin above named was exhausted very soon after publication and as there is still a demand for the bulletin a review of the work of that year is incorporated in this report, which is therefore separated into three portions; Part I having to do with the results of 1891—1892; Part II with the results of 1892—1893; and Part III with conclusion and matters of general interest connected with the subject.

In the back of the bulletin is printed a complete table of the analysis of all beets which have been received at the Experiment Station in a suitable condition. Analyses numbered from 1 to 96 were made during the season of 1891—1892, and those from 96 to 161 during the season 1892—1893.

Following this table will also be found another showing the analyses of Oregon grown beets sent to Washington D. C. to the U. S. department of Agriculture. In the front of this bulletin will be found a map upon which the places where beets containing over 14 per cent sugar have been grown, and also the average of all the analyses for each county.

Part I.

The beet is a hardy biennial plant indigenous to Southern Europe and more recently introduced into Canada and the United States, and for its successful production depends mostly upon climate, soil and cultivation. To determine the best methods of cultivation as suited to our local conditions requires cultivation upon a larger scale than was feasible in these investigations besides being a line of work belonging to the Agricultural Department, hence no conclusions are attempted in this direction.

Each year arrangements were made with farmers in different portions of the State to cultivate a small plat of beets, the seed being furnished them

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by the Station. Although there was a hearty and ready response to the Station's offer to furnish seed to those who would agree to forward samples for analysis, accompained by a report, —blanks for which were furnished— there were many who never responded to a single inquiry after they had received the seed, notwithstanding the fact that they had expressly agreed to report results. To those whose careful culture of the beets rendered it possible to conduct the experiment so successfully, as well as to the assistant Chemist, our heartiest thanks are hereby expressed.

In addition to those not reporting in any way there were some who seemed to think that no report was desired or expected if the crop was not successful and the results were not sufficiently large to "boom" the country. The Station was in pursuit of the facts in the case, and if the State or a county cannot produce good beets it is just as important for the public to know it, that failure may be avoided, as it is if the conditions, prove favorable. The Station does not exist to "boom" any portion of the State, but is in search of *bare facts*, be they favorable or unfavorable.

SEED AND CULTIVATION.—The seeds used in the investigation were imported varieties, and the following directions for cultivation, which were taken from the most competent authorities in this country and Europe, were sent out with each package of seeds.

Method of Growing Sugar Beets to be followed by those taking part in the Co-operative Experiments with Sugar Beets in Oregon.

SOIL.—This should, where possible, be a light loam, preferably containing some lime. The land should be well drained. The beet gets the greater part of its food from the ground at a depth of 8 to 12 inches. Hence freedom from excess of water is necessary.

PREPARATION OF LAND.—The land selected should have been plowed the fall before planting of seed. As soon as it can be properly worked in the spring the land should be plowed again, this time to the depth of 12 inches. Allow to lie until about one week before the time of seeding. Then plow once more to the depth of 4 to 5 inches, and work the soil up into a fine and *light* condition (i. e., do not pack it down with a drag). After allowing land to lie 5 to 7 days plant the seed. The object of allowing the land to lie is that sufficient moisture may be drawn from below for the germination of the plant, and that the land may be warmed by the sun, after pulverization. No manure should be applied unless in the shape of well rotted compost put on in the fall. The land on which the beets are to be grown should be measured approximately, and enough ground planted so that it will be possible to take the eightieth of an acre from the plot without including any *outside* rows. In ordinary soil the rows should be eighteen inches apart. In very rich less; and in poor soil more than that distance apart: The conditions should be such that the beets can not attain a greater weight than two pounds each. The seed should be planted one-half to three-quarters of an inch deep, and about 20 pounds of seed to the acre. Plant, where possible, in April.

CULTIVATION.—This should be thorough, and should begin as soon as the plants show in the row. When the beets have put out four leaves, thin them out so as to leave the plant standing about 4 to 6 inches (not farther) apart in the row. The weeds should be kept down and the ground well stir-

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red. It should be remembered that a beet which grows up out of the ground is worthless for sugar, also that the beets must not attain to a weight greater than two pounds apiece, and must be smooth and tapering in shape.

CLIMATE.—In the matter of climate Oregon seems well suited to the sugar beet as is shown by the following tables and the chart on the opposite page. Temperature curves are given for the Willamette Valley and Eastern Oregon simply as a matter of convenience, the curves for Southern Oregon running very close to that of the Eastern portion of the State.

The season for the growth of beets may be divided into three periods—that of germinating; that of plant formation; and that of sugar storing. The following is a comparative table showing the temperature averages for Germany and certain parts of Oregon during these periods.

TEMPERATURE TABLE FOR PERIODS OF GROWTH,

Periods of Growth	Av. Temp. Foreign.	Av. Temp. East. Org'n	Av. Temp. Willam. Val	Av. Temp. South'rn Or
First.....	49.1	56.0	52,5	53.1
Second.....	63.3	65.0	64.4	64.5
Third.....	56.3	64.4	63.3	54.8

For charts showing the average monthly temperature for the season of 1891—1892, and its relation to the normal the reader is referred to page 10.

As to rainfall the average amount does not differ much from that of beet growing regions of other countries, yet it is not so evenly distributed. It will be true with this as with all crops in the northwest that the *seasonal* precipitation is that to which attention should be directed, for in Oregon, as in California, nearly all the precipitation takes place during the "rainy season." To show this the following table is used.

SEASONAL PRECIPITATION TABLE. †

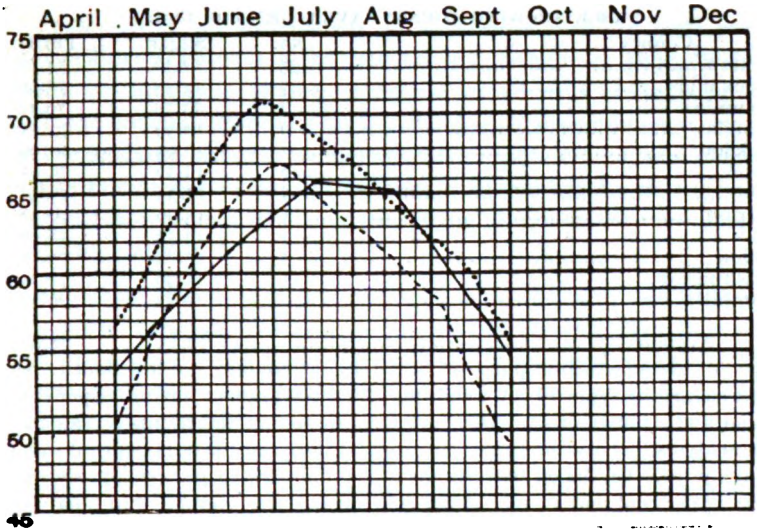
LOCALITY.	SPRING. Mar-May	SUMMER. Jun-Aug	AUTUMN. Sep-Nov	WINTER Dec-Feb	Years Obs'v
LaGrande, Eastern Oregon	4.10	2.26	2.38	15.81	2
The Dalles, Central Oreg'n	2.93	.88	3.98	8.50	13
Albany, Willamette Valley	10.07	2.43	9.75	22.76	8
Roseburg, Southern Oregon	8.22	1.79*	8.00	17.60	10
Newport, Coast Region.....	11.60	8 16	10.72	34.50	2
Ashland, Southern Oregon.	4.79	1.61	4.90	11.63	4
Lakeview, Lake Region.....	4.32	3.09	3.18	6.79	3

*For two months only. †Compiled from State Weather Bureau data.

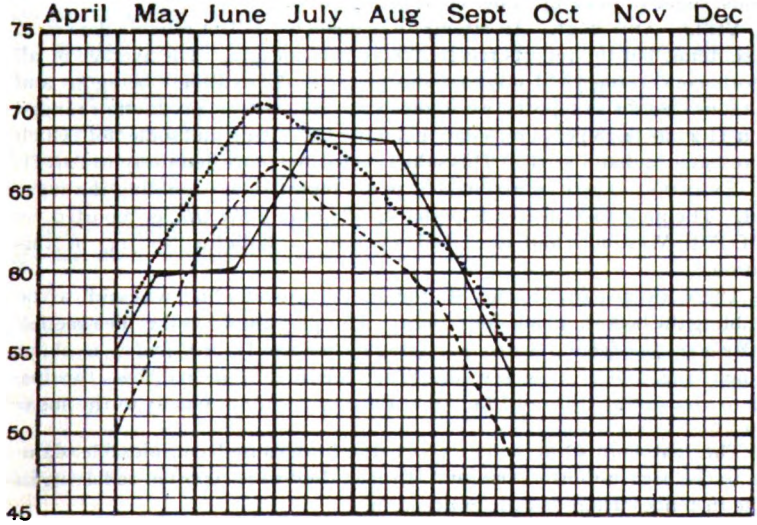
SOIL.—"Vilmorin considers that any good soil that will grow wheat and has an arable stratum of 12 to 15 inches will be well suited to this culture." There is little more that need be said concerning this further than that new ground should never be used, and that a stiff clay soil is unfavorable. While soils carrying alkali do not materially affect the amount of sugar in the beet, its presence in the soil so affects the sugar stored in the beet as to render it difficult of crystallization, hence beets raised on such soil cannot be used for the manufacture of sugar.

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Comparative Temperature Charts.



France .....
Germany - - - - - -
Willamette Valley———



France .....
Germany - - - - -
Eastern Oregon ———

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RESULTS.—The analyses made at the Station during the season of 1891 -1892 may be summarized as follows:—

TABLE SHOWING COUNTY AVERAGES FOR 1891.

County	No.	Sugar.	Purity.
Benton	39	12.30	74.12
Clackamas	7	14.55	77.30
Columbia	1	13.74	79.42
Douglas	9	12.99	73.45
Jackson	3	18.93	80.99
Lane	16	14.32	79.95
Linn	5	13.54	79.91
Marion	1	15.99	78.38
Polk	1	14.72	78.08
Union	3	15.84	79.89
Washington	11	13.96	78.79
Yamhill	1	10.73	76.64
Average		14.13	78.08

For manufacturing purposes beets should contain not less than 12 per cent sugar; the typical beet weighing about 600 grams,* having 14 per cent sugar and a purity of about 80. An examination of the results reveals that the analyses had a wide range: viz: from 6.77 per cent to 22.44 per cent sugar in the juice. Of the 95 analyses made 8 fell below 10 per cent; 76 showed over 12 per cent and 37 over 14 per cent sugar. An average of 81 analyses for Willamette Valley shows 13.76 per cent sugar and a purity co-efficient of 77.89; the average beet weighing a little over 1¼ pounds, while an average of 10 analyses of beets from Southern Oregon showed 13.38 per cent sugar with a little larger beet. For the entire state the average weight was 608.5* grams; sugar in juice 14.13 per cent; purity 78.08.

YIELD AND COST.—An attempt was made to collect reliable data as to these items, but the reports received were very meagre. The average of all reports concerning yield was 20.5 tons per acre, the extremes being 5.1 and 44.2 tons So far as reports were received the cost of production ranged from 11.25 to 24.18 per acre, some including harvesting and some not, which represented all hand work. This subject is treated more definitely in Part II.

ENEMIES.—There were but few pests reported as troubling the sugar beet. The most to be feared is perhaps, *Monoxia guttulata*, as reported by Prof. F. L. Washburn and described by him in Bulletin No. 14, of this Station.

There was also sent to this Station another insect which was said to be troubling the beets in Clackamas county. This pest known as the "flee beetle" —*Phylotreta decipiens* (Horn) belonging to the family *Halticidæ*—is about ⅛ inch long, and of a black color. They are found on radishes, turnips, potato vines etc. It is not likely that they are a serious enemy to the sugar beet.

The "cut worms" were also reported to have caused considerable damage to the beet in Central Oregon. In fact, they were reported as having in some instances destroyed the entire crop.

Gophers also caused some trouble in Benton county and are said to have shown a decided preference for the sugar beets.

*A gram corresponds approximately to .03528 ounces.

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Part II. Experiments of 1892--1893.

PLAN.—As in the experiments of the previous year the beets were raised in different portions of the state, the seed being more generally distributed and more varieties used. From the experiments of the previous year it had become evident that beets containing a high percentage of sugar could be produced, hence in the experiments of 1892—1893 it was sought not only to confirm the results of the preceeding year but also to ascertain something more definite relative to the cost and the yield, and a few points of scientific interest.

For the investigations of 1892 the following varieties were used Desprez, Early Rose, Vilmorin Improved, Klein Wanzlebener and White Imperial all of which are favorite kinds, the first being much used in California. Unfortunately the seed was delayed in reaching us so it could not be distributed to the farmers as early as it should have been to secure the best results. Had the seed reached us in due time it could have been put into the ground in April for at that time there was a favorable time for seeding, but by the time the seed had been distributed cold weather set in and continued till May after which the weather became very dry rendering the conditions for a fair trial very unfavorable. The temperature conditions for the season are indicated on the charts given on the following page, which also give the normal temperature and that for the previous season. The rainfall for the season was below the normal and reports all read "very dry," "extraordinarily dry," "weather very unfavorable." In fact nearly all the beets in the Eastern portion of the state failed to mature, and in many instances the seed failed even to germinate. So far as the season's climate is concerned, then, the experiments were greatly handicapped and we were "in pursuit of knowledge under difficulties".

The cultivation for this season was the same as for the previous year except that the rows were placed 20 inches apart.

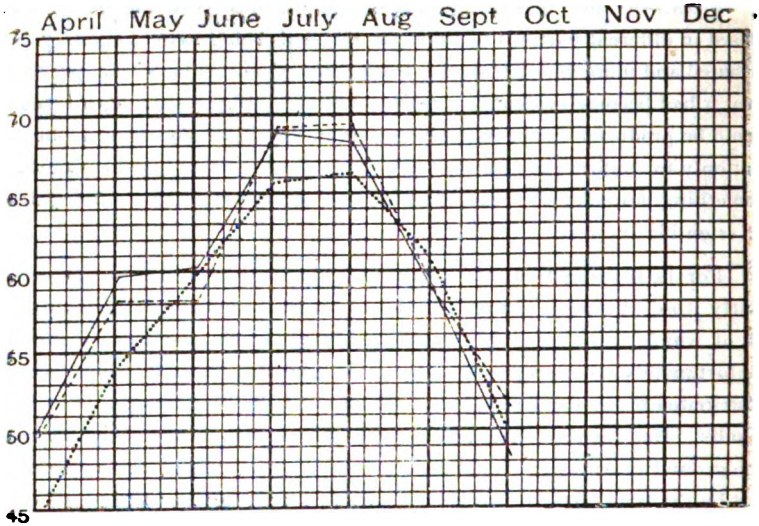
Owing to the disturbed condition of the experiment the results are doubtless poorer than would have been the case had the season been one of more nearly normal condition. Still the results confirm the conclusions of the previous year that Oregon possesses the conditions necessary for the production of excellent beets for the purpose of beet sugar manufacture.

The complete analyses for this season are recorded in the table at the back part of this bulletin being numbered from 96 to 161 inclusive.

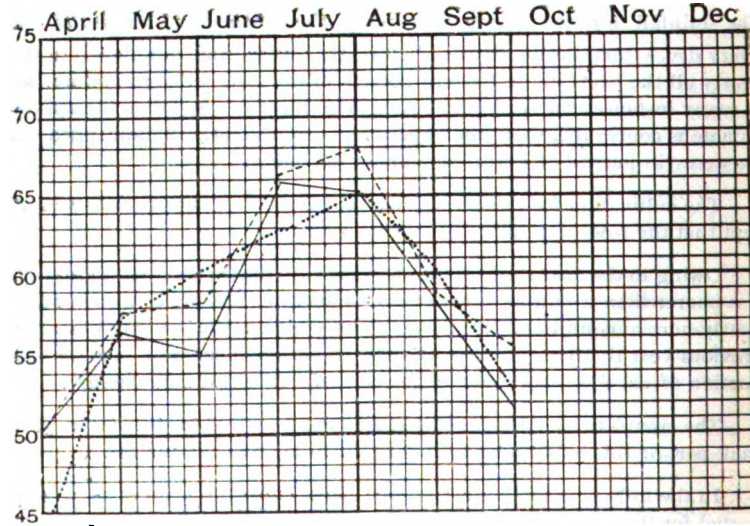
In the following table are recorded such cultivation notes as were reported for the above numbers and while they may not be of interest to the general reader, it is hoped they will be of value to those who desire to *study* the matter of sugar beet growing in Oregon.

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Comparative Temperature Charts.



Normal for Eastern Oregon ———
Mean " " " 1891 - - - - -
" " " " 1892 . . . . . .



Normal for Willamette Valley———
Mean " " " 1891 - - - - - -
" " " " 1892 . . . . . .

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CULTIVATION NOTES FOR 1892--1893.

In the following table is given the amount of cultivation which was given to each sample analyzed so far as reports could be obtained.

Lab. No.	NAME OF GROWER COUNTY	Av wt of Beets in Grams.	Per cent Sugar in Juice.	Purity.	Report'd yld tons.	Soil.	Date of Planting	Date of Harvesting	CULTIVATION.
96	E. F. Meisner, Josephine	392	16.0	74.41	15.2	Gravelly clay	Apr 19	Nov 14	Cult. 3 times, hoed 3 times, irrig'ed 3 times
97	A. J. Thompson, Clackamas	650	15.2	86.85	9 3	"Shotland."	May 11	Sept 26	Hoed four times.
98	J. J. Odale, Union	405	16.1	90.95	....	Drk Sd' loam	May 7	.....	Hoed twice.
99	A. J. Goodbrod, Union	817	21.0	85.50	Enorms	Sandy.	June 12	Sept 27	Pulled weeds once.
104	S. P. Reeder, Washington	522	18.2	78.68	14.1	Black loam.	May 27	" 26	Cultivated six times.
109	T. E. Hills, Jackson	783	15.0	84.74	17.4	Granite, Sandy.	April 20	Oct 11	Irrigated.
110	J. M. Hirsh, Union	605	17.0	.....	....		.....	.....	.....
117	H. Buxton, Washington	1045	14.3	88.80	....	Dark loam.	May 16	Oct 21	.....
119	G. R. Woodruff, Benton	620	9.4	81.70	29.4	Sandy loam.	May 5	Nov 1	Plowed twice, hoed five times.
120	" "	640	12.9	82.17	18.0	" "	" 5	" 1	" " " " "
121	" "	776	11.9	82.17	38.0	" "	" 15	" 1	" " " " "
123	W. L. Tower, Douglas	192	20.6	84.32	8,2	Red loam.	April 22	Oct 29	Plowed twice, hoed twice.
124	J. D Rowell, Washington	341	19 0	67.80	21 0	Red hill.	May 6	" "	Cultivated four times.
128	B. D. Dyer, Douglas	291	11.3	79.02	6.7	Granite.	June 1	.....	Hoed twice
129	R. E. Cartwright, Lane	568	15.1	87.00	30 4	Clay.	May 25	Oct 28	Plowed and hoed once.
130	M. Lemmer, Douglas	458	15.0	84.90	17.4	Sandy loam.	April 15	" 27	Garden.
131	O. P. Pointer, Washington	538	14.7	71.80	8,1	Clay	May 28	" 31	Hoed twice.
132	M. Snyder, Linn	617	17.1	73.40	11.7	Sandy loam	April 8	" 29	Plowed once, hoed three times.
133	J. D. Stewart, Polk	750	18.7	76.60	21.7	Black loam	May 15	" 31	.....
134	Jas Edson, Yam'hill	1416	19.3	77.20	....	" "	" 18	" 27	.....
137	M. O Lownsdale, Yamhill	1050	12.5	78.60	47.0	Red hill	" 20	" 20	Subsoiled to 19 in, cult. twice, hoed 4 times.
138	C. J. Bishop, Benton	860	14.2	85.00	23 9	Sandy loam	April 10	" 15	Cultivated four times, hoed four times.
139	M. J. Duffy, Union	676	21.5	88 10	5.0	Black loam	May 10	" 15	Hoed and irrigated twice.
140	R. S. Reed, Lane	660	15.3	88.10	22,8	" "	" 13	Nov 7	Hoed twice, weeded twice.
142	J. K. Sampson, Yamhill	352	14.8	87.00	6.8	" "	" 26	Nov —	Hoed and plowed once,
144	W. E. Smith, Malheur	570	20.2	84.90	12.0	Sandy loam	" 10	Oct 20	Hoed three times.
145	C. D. Nain, Polk	1623	14.0	72.20	44.4	Black loam	April 20	Nov 5	Hoed four times, cultivated four times
146	J. H. Rinck, Washington	165	17 7	76.60	10.5	Sandy loam	May 11	" 7	Hand cultivated once.
147	William Bogue, Benton	873	15.0	80.60	15.1	" "	" 20	" 1	Cultivated three times.
148	J. W Beatty, Marion	840	13.0	80.70	45.0	" "	" 5	" 14	Cultivated and hoed six times.
150	C. C. Stanley, Union	310	23 8	91.90	....	" "	" 13	" 4	Plowed 15 inches, spaded, hoed twice.
151	John End, Wasco	330	21.1	90.50	7.5	Loam	April 16	Sept 22	Plowed twice, cultivated once.
153	J. H. Bard, Douglas	623	14.5	77.90	40.4	Clay loam	May 20	Nov 12	Cultivated four times.
154	" "	843	16.1	75 90	36.1	" "	" 20	" "	" " "
157	J. E. Reynolds, Union	633	20.9	85.42	22.0	Heavy "	" 1	Oct 1	Hoed three times.
158	Robert Deal, "	236	16.2	76.04	.....	Black loam	" 1	" —	.....
159	F. Clairhorn, Douglas	323	13.2	82.30	.....	Clay loam	April 1	Nov 30	Cultivated once.
160	W. H. Norcross, "	803	10,9	83.20	17.4	Sandy loam	May 1	" 24	Cultivated six times, hoed twice.

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Summary of Results for 1892.

Seed was sent to 140 farmers 20 of whom reported absolute failure of crop on account of unfavorable weather, and two on account of insect pests and squirrels.

The average of all analyses for the State was 15.7 per cent sugar in the juice with a purity of 78.08 against 13.75 per cent and a purity of 77.57 for last season. Out of the 65 analyses made only 11 indicated less than 12 per cent sugar in the juice, and 41 samples indicated over 14 per cent, the extremes being 9.4 per cent and 23.8 per cent. The average for the different natural divisions of the state were as follows:

Willamette Valley, 44 samples..... ....14.7 per cent.
Eastern Oregon, 11 samples.. .....19.2 ,, ,,
Southern Oregon, 10 samples..... ....15.1 ,, ,,

Expressed by counties the averages are as follows:

COUNTY.	No. Analyses	Average for 1891	No. Analyses	Average for 1892	No Analysis	Average for U. S. Dept. Agriculture	Mean of Analyses made at Station.	Mean of all Analyses.
Benton.....	39	12.30	20	12.80	5	14.34	12.30	12.57
Clackamas.	7	14.55	1	15.10	3	15.36	14.62	14.87
Columbia..... ..	1	13.74	0	.....	3	15.30	13.74	14.91
Coos.....	0	.....	0	.....	5	14.56	.....	14.56
Douglas	9	12.99	9	15.20	1	17.74	14.28	14.48
Jackson.....	3	18.93	1	15.00	1	18.94	17.94	18.34
Lane.....	16	14.32	2	15.20	6	14.24	14.42	14.40
Linn.....	5	13.54	1	17.10	1	14.15	14.13	14.13
Marion.....	1	15.99	2	13.80	2	14.15	14.59	14.38
Polk....	1	14.72	5	14.50	1	12.10	14.54	14.19
Union.....	3	15.84	7	19.80	2	14.32	18.61	17.89
Washington.....	1	13.96	10	15.50	3	12.49	14.69	14.41
Yamhill.....	1	10.73	5	13.70	0	.....	12.96	12.95
Josephine.....	0	.....	2	15.70	0	.....	15.70	15.70
Wasco.....	0	.....	1	21.10	0	.....	21.10	21.10
Malheur.....	0	.....	1	20.20	0	.....	20.20	20.20
Sherman.....	0	.....	0	.....	1	13.55	.....	13.55
Umatilla.....	0	.....	0	.....	1	15.12	.....	15.12

Gleaned from Reports.

96.—"The beets have gained 30 lbs. to the row (85 feet) since Oct. 1st."

97.—"Owing to the heavy rains in April, planting was very late, and drought later reduced the aggregate yield.

The land was new, had been in potatoes one year, no manure was used, a little plaster was sown at planting time. The result is not flattering but shows what may be done under very unfavorable conditions; upon land which had been longer in cultivation, and with a favorable season I should feel sure of 15 or 20 tons per acre. I base my "price per ton" upon, not less than 10 acres and a yield of 15 or 20 tons per acre, with cost of raising reduced to a minimum by using horse power."

104.—"I think sugar beets could be raised for $5.00 per ton in a favorable season."

109.—"The ground received water by sub-irrigation from sulphur springs."

117.—"Ground was two dry when seed was planted."

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123.—"The season was very unfavorable and the cultivation was not perfect."

118.—"At $4.50 per ton the whole crop would have to be taken."

130.—"During the latter part of September and first of October about 10 per cent died and rotted from top downward."

137.—"I had bad luck with the seed sent me. Only 40 per cent of one lot came up and of another lot only about 50 per cent. So that without transplanting I could give only an approximate estimate of the yield per acre. I could not afford to grow them at any price around $4.00 per ton. I can use my land to better advantage with other crops. This was my first experience with any thing of the kind and could improve 50 per cent another year."

144.—"My plot of beets were a partial failure the seed sown in drills on the 10th of May. It was then raining and continued wet and cold for three weeks and only about one-third of the seed came up. These grew well, however, during the season, free from insects or disease."

151.—"This has been a very bad season for testing anything in the nature of beets. I do not think beet culture would be a success here without irrigation."

161.—"Beets should have been gathered before receiving so much rain —should be planted in April."

Concerning the failures most of the letters read about as the following:—

THE DALLES, Oregon, Oct. 29, 1892.

G. W. SHAW, Chemist Or., Exp. Station,

DEAR SIR:—I am very sorry to announce to you that I have none whatever. I planted the seed sent to me carefully and though late when planted, quite a good many seeds germinated. When the scorching weather came they *dried up* as did most all of my garden. The only root crop which amounted to anything with me was carrots which do finely here. I am sorry to report thus but do not see that I could in the least help matters. The soil was in fine tilth (summer fallowed the year previous) and free of weeds. I used a Planet, Jr. seed drill to plant the seed and cultivated them with a Planet, Jr. wheel hoe, besides doing a little hand weeding. With best wishes for success to your efforts, I am, Yours truly,

ALBERT S. ROBERTS, Box 107 The Dalles.

It will be evident from the data given above that in spite of the unfavorable conditions the results have surpassed those of a year ago.

Part. III.

As before stated, one of the things sought by this year's experiments was relative to the yield that might be expected from a sugar beet crop. The data given below will be drawn from the experiments of the entire two seasons. Altogether the reports for the present season are quite complete on this point. The results given are calculated from a measured plot according to the following instructions which were sent with each package of seed, this being the method used by the U. S. Department of Agriculture. This method was used in order that the results obtained might be comparable with those obtained elsewhere.

"When the beets seem to be mature select an average row and gather every plant along a distance which should vary as follows, according to width between rows:

From	rows	16	inches	apart	gather	75	feet.
"	"	18	"	"	"	66⅔	"
"	"	20	"	"	"	59.8	"
"	"	22	"	"	"	54¾	"
"	"	24	"	"	"	50	"

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The number of beets growing in the row, of the length above mentioned, must be counted. The tops are then to be removed, the beets carefully washed free from dirt, wiped and weighed. When the row is not long enough to meet the conditions, take enough from the adjacent row to make up the required length. The number of beets harvested multiplied by 435.6 will give the total number per acre. The total weight of beets harvested multiplied by 435.6 will give the yield per acre."

Upon the above basis the following reports were made:

J. S. Powell	Benton	15.8
College Farm	"	5.8
G. R. Woodruff	"	18.0
"	"	38.0
C. J. Bishop	"	23.9
William Bogue	"	15.1
Average		19.1
A. J. Thompson	Clackamas	9.3
D. S. K. Buick	Douglas	25.0
W. L. Tower	"	8.2
B. D. Dyer	"	6.7
M. Lemmer	"	17.4
J. H. Bard	"	40.4
"	"	36.1
W. H. Norcross	"	17.4
Average		21.6
Edward Albright	Jackson	12.0
T. E. Hills	"	27.4
Average		14.7
H. C. Perkins	Lane	18.0
J. H. Crow	"	9.5
R. S. Reed	"	22.8
R. E. Cartwright	"	30.4
Average		20.2
M. Snyder	Linn	11.7
W. E. Smith	Malheur	20.2
J. Voorhees	Marion	21.5
J. W. Beatty	"	45.0
Average		33.2
A. W. Lucas	Polk	30.0
J. D. Stewart	"	21.7
C. D. Nain	"	44.4
Average		32.0
M. J. Duffy	Union	5.0
J. E. Rynolds	"	22.0
Average		13.5
J. H. Rinck	Washington	17.0
"	"	10.5
John Henry	"	5.0
S. P. Reeder	"	14.0
J. D. Rowell	"	21.0
O. P. Pointer	"	8.1
Average		12.6
M. O. Lownsdale	Yamhill	47.0
J. H. Sample	"	6.8
Average		26.9
E. F. Meissner	Josephine	15.2

An examination of this table reveals the fact that in spite of the unfavorableness of the season the average for the state was 23.18 tons per acre against 20.5 tons per acre for the year previous. In connection with this subject nothing more to the point could be said than the following:— "But results worked out on paper always vary from actual experience, and so it has happened with sugar beets. In California the yield has reached as high as 61 tons per acre (the highest reported for Oregon so far is 44.2 tons. G. W. S.) while in Nebraska the average during the past two years has been under 10 tons per acre."

The average yield at Watsonville, California, in 1886 was 21 tons per acre and the following averages have been obtained in other states:

Minnesota	15.0 tons per acre.
Wyoming	7.5 " " "
S. Dakota	8.1 " " "
Nevada	20.0 " " "
Colorado	26.0 " " "
Iowa	20.0 " " "
Indiana	30.0 " " "
New York	19.5 " " "

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It is evident that, as with every other crop, the yield must necessarily depend upon many things, as variety, distance between rows, soil, cultivation, and season, hence this will always be a more or less varying factor. I think, however, that for the Willamette Valley, and Southern Oregon in general, an average of 15 tons per acre is a very conservative estimate.

In Eastern Oregon the uncertainty of the season renders the ability to irrigate almost an essential condition, and if this is met, there can be little doubt but that the yield would even exceed that for Willamette Valley.

CULTIVATION.—Too much cannot be said upon this subject, for in the cultivation lies the secret of success in sugar beet culture. It has been said "The sugar is hoed into the beet," and this is literally true.

Well drained land is necessary, for the beet demands a deep, loose soil so the long tapering tap root may penetrate and drink well of the soil moisture, the development of sugar not reaching a high per cent in irregular shaped beets. It is essential that the beets be *kept close together in our soils* or they grow to enormous size. Some having been sent to us weighing as much as 10 lbs. Such beets are worthless for sugar and a manufacturer would not take them as a gift. The sugar varies inversely as the size of the beet. Beets for the manufacture of sugar should not attain a weight of more than 2 pounds. Pagnoul has conducted experiments extending over 8 years intending to show this.

DISTANCES APART IN INCHES.	PER CENT SUGAR.	YIELD PER ACRE.
Wide distance, 20 x 20	10.2	28.40
Narrow " 17 x 8	12.2	36.05

The same may be shown by the following Oregon produced beets, selected at random from the tables:

SIZE.	VARIETY.	Wt. in grams.	Per cent Sugar in juice.	Purity.
Small beet.	White Imperial	192	20.60	84.32
"	Klein Wanzlebener	341	19.00	67.80
"	White Imperial	250	16.70	88.30
"	Early Rose	165	17.70	76.60
"	Klein Wanzlebener	236	16.20	76.04
"	Vilmorin	350	18.00	82.13
Average		256	18.00	79.19
Medium beet.	White Imperial	538	14.70	71.80
"	Klein Wanzlebener	865	14.15	81.79
"	White Imperial	803	10.90	83.20
"	Desprez Early Rose	980	14.00	82.90
"	Klein Wanzlebener	920	15.99	76.38
"	Vilmorin	1021	13.40	54.10
Average		856	13.86	75.36
Large beet.	White Imperial	1623	14.00	74.20
"	Klein Wanzlebener	1880	14.41	80.55
"	White Imperial	1416	19.30	77.20
"	Desprez Early Rose	1970	11.90	85.00
"	Klein Wanzlebener	1700	12.88	80.00
"	Vilmorin	1700	9.81	68.12
Average		1715	13.71	77.51

One of the most important of all things for the farmer to understand is that at all times must the root be kept below the ground. Bulletin No.

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67, Guelph Agricultural College Ontario, calls attention to this and gives the following to illustrate.

		Amt. of sugar	Purity.
Well grown, average of	top	15.5	82.7
	bottom	16.6	83.0
Poorly grown " "	top	11.4	69.9
	bottom	13.6	77.2

COST of RAISING.—This is one of the most pertinent questions relating to the subject, and at the same time is the most difficult one to answer satisfactorily, since there are so many factors in the problem. The question "At what price per ton could you afford to raise beets in quantity," was asked on the report blank sent out this year, and of the 28 farmers who answered the question, 15 stated $4.00 or less, some stating as low as $2.00. One or two named the extreme price of $8.00, but this was based upon all hand labor. The agricultural department of the college failing to keep an accurate record of the experiment renders it impossible to give definite data from that source. The estimates for the previous season ranged from $11. 25 to $24. 18 per acre, some including harvesting and some not, and none including the cost of hauling to market. I insert the statement of a gentleman from California which covers the question as fully as possible, and the items given do not differ far from the same items in this state.

"A. F. Richardson, two miles from factory, eleven acres: Plowing and harrowing, $110; sowing $6; harrowing and sowing, $3; 4 days' cultivation first time at $2—$8; 23 days' thinning at $1.25—$28.75; 24½ days' thinning and hoeing at $1.25—$30.65; 5 days' hoeing at $1.25—$6.25; 9 days' hoeing at $1.75—$15.75; 7 days' hoeing at $1.75—$12.25; 9½ days' hoeing, second time, at $1.75—$7; fixing plow, $2.50; two knives, $1.50, 4 baskets, $3.50; topping and loading, 170. 05 tons at 80 cents—$136. 04; hauling at 50 cents, $85; plowing up at 20 cents, $34; total, $508. 59; yield, 170.05 tons value, $821.81; net profit, $413. 22 net profit *per acre*, $37. 56."

These results were obtained in 1889 when the farmers were practically unacquainted with the most economical methods of cultivation and it is safe to say that with a little more experience in the method of working, most of the items would be rendered somewhat lower. These figures are not theoretical, but are the actual accounts of a beet grower

THE MANUFACTURER AND THE FARMER.—It would certainly be a grand thing for Oregon to have a sugar factory located within her limits, officered by men of experience and ability, and while we would not say anything to discourage yet there is no royal road to riches even through the sweetness of the sugar beet, and success will only come through the efforts of the patient, careful, and persevering.

The question as to whether or not farmers should grow beets depends upon whether or not factories are established to use the beets, and *vice versa*, hence it is a question of double issue and can only be solved by co-operation. It is a lamentable fact—yet no less a fact—that the farmer looks upon the manufacturer as one who is at all times and under all circumstances trying to get the better of him, and this serves as a great barrier to success in the production of beet sugar.

In this industry, as in no other are the producer and the manufacturer linked hand in hand, and what is money in the pocket of one is also money in the pocket of the other, and neither can prosper without the other. From the standpoint of the manufacturer there are many

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things to be considered before the establishment of a sugar factory, and after it has been shown that the natural conditions are favorable the main question is the supply of beets. The enterprise requires a large capital, and if Oregon enters the arena and is successful it will be with the most modern appliances, and true economy would demand an outlay of not less than $250,000. A plant of this capacity would require a large number of beets, the growing of which would require at least 5000 acres of land. Such a factory could well be located between two townships, and not be handicapped by the hauling distance.

The farmer's side of the question is one that can be practically settled by experiments, and in fact, outside of the actual cost of raising larger crops has been demonstrated in the experiments, but the cost of raising 10 acres of beets, when equipped for the work, is of course relatively less than for a small plat of land, hence the cost will be less than the average reported, and I am confident they can be raised at $4 per ton and leave *a fair* profit.

The manufacturer practically has all the risk to run unless he can actually be assured of a sufficient supply of beets. If he cannot be thus assured of course we have no factory, for no man or combination of men would invest $250,000 in an enterprise which would be entirely at the caprice of the farmers. There must be some written agreement binding both parties.

It is not within the scope of this publication to discuss the methods of organizing and conducting such an enterprise as the one in question, although the writer would be pleased to correspond with any parties interested in the subject, and offer any suggestion that he may be able.

CONCLUSIONS.—1—Good sugar beets can be produced in Oregon.

2—They can be raised at a price a factory can afford to pay.

3—The yield compares favorably with that of states now raising beets for the manufacture of sugar.

4—The crop of beets cannot be depended upon in some parts of the State unless irrigation is practiced.

5—That the success of the farmer will depend more upon skill and industry than on the soils, for poorly cultivated beets contain a lower percentage of sugar and purity than well cultivated.

6—Large beets do not contain so large a percentage of sugar as small beets and the purity is less.

7— Upon no condition should farmers grow beets to the exclusion of other crops, but should make this a rotation crop, substituting for bare fallow, if a factory should be started near them.

8—The amount of cultivation necessary for beets in Oregon renders it important that no one farmer should attempt to care for more than 12 acres per season.

9—The plants should be left as far apart as possible and not allow the roots to attain a weight of more than 2 pounds in order that as much cultivation as possible may be done by machinery.

10—If any state can manufacture its own sugar, or any part of it, successfully, Oregon should be able to do so since she has all the natural requirements.

In view of the foregoing all possible encouragement should be given toward directing attention to Oregon as a State suitable for this industry and to securing the attention of any one interested in such an enterprise.

The farmers have it mainly in their own hands for their willingness to each contract to grow a small acreage of beets will be the main factor for the manufacturer to handle.

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Table of Analyses of Sugar Beets, 1891--1893.

	GROWER.	LOCALITY. POST OFFICE & COUNTY	SUGAR. Weight in Grams.	Sugar in Juice	Sugar in Beet.	Solids not Sugar.	Brix.	Purity.	Pounds Sugar Per Ton.	VARIETY OF BEETS.
1	Edw. Albright	Ashland, Jackson,	244	14.00	13.1	5.3	19.3	72.53	280.0	Klein Wanzlebener.
2	A. W. Lucas	Monmouth, Polk	624	14.72	13.3	4.2	18.8	78.08	294.4	" "
3	D. S. K. Buick	Roseburg, Douglas	1700	9.81	9.3	4.6	14.4	68.12	196.2	" "
4	do do	do do	1140	10.07	9.1	3.9	14.0	71.21	201.4	Vilmorin Improved.
5	J. Voorhees	Woodburn, Marion	920	15.99	14.6	4.4	20.4	78.38	319.8	Klein Wanzlebener,
6	H. C. Perkins	Llewellyn, Lane	739	17.06	16.0	4 3	21.3	80.09	341.2	" "
7	do do	do do	600	14.96	12.7	5.3	20.3	69.26	299.2	" "
8	L. F. Wilson	Corvallis, Benton	389	13.46	10.9	6.3	19.8	66.36	269.2	Unknown.
9	College Farm	do do	375	13.28	12.0	4.4	16.4	80.97	265.6	Vilmorin.
10	H. C. Perkins	Llewellyn, Lane	1200	17.70	16.1	4 3	22.0	80.45	354.0	Klein Wanzlebener.
11	College Farm	Corvallis, Benton	335	12.03	11.4	3 1	15.2	79.91	240.6	Lane's Imperial.
12	do do	do do	250	12.39	11.6	2.5	14.9	83.15	247.8	" " "
13	do do	do do	330	14.63	12.7	2 7	17.3	84.57	292.6	Klein Wanzlebener.
14	do do	do do	216	14.02	12.6	2 8	16.8	83.45	280.4	" "
15	do do	do do	208	16.35	14.0	3.5	19.8	82.56	327.0	Dippe Klein Wanzlebener.
16	do do	do do	312	13.50	11.9	4.5	17.0	79.41	270.0	" " "
17	J. S. Powell	Philomath, do	384	13.08	12.4	3.8	16.9	76.80	261.6	Vilmorin Improved.
18	do do	do do	388	11.36	10.8	5.2	16.6	78.48	227.2	" "
19	do do	do do	465	11.97	10.8	5.0	17.0	70.45	239.4	" "
20	do do	do do	594	13.07	11.8	5 1	18.2	65.06	261.4	" "
21	C. J. Bishop	Tidewater, do	397	14.46	13.7	5.1	19.6	73.77	289.2	" "
22	College Farm	Corvallis, do	185	12.86	11.5	3.0	15.9	80.88	257.2	Dippe Klein Wanzlebener.
23	do do	do do	285	12.51	11.3	3.3	15.9	78.61	250.2	Klein Wanzlebener.
24	do do	do do	200	9 73	9.0	2.5	12.3	79.10	194.6	Lane's Imperial.
25	do do	do do	200	13.00	11.9	2.9	15.9	81.76	260.0	Vilmorin Improved.
26	do do	eo eo	780	12.88	11.5	3.7	16.6	77.59	257.6	Klein Wanzlebener.
27	do do	do do	642	12.05	11.0	4.7	16.8	71.78	241.0	" "
28	J. D. Wilson	Yoncalla, Douglas	348	14.75	14.0	3.8	18.5	79.72	295.5	" "
29	do	do do	496	14.32	13.3	6.0	20.4	70.16	286.4	Vilmorin Improved.
30	A. R. Shipley	Oswego, Clackamas	.....	12.00	10.9	3.1	15.1	79.47	240.0	Dippe Klein Wanzlebener.
31	do	do do	945	12.71	11.8	4.6	17.4	73.04	254.2	" " "
32	John Rickard	Corvallis, Benton	1100	9 81	8.4	5.1	15.0	65.40	197.	Klein Wanzlebener.

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33	John Rickard	Corvallis, Benton	700	6.76	6.0	4.7	11.5	58.78	135.2	Vilmorin.
34	do	do do	650	8.16	7.0	3.4	12.6	64.92	163.2	"
35	I. N. Sanders	Union, Union	350	18.07	16.6	4.9	22.0	82.13	361.4	"
36	do	do do	475	15.52	14.4	3.7	19.3	80.04	210.4	"
37	C. L. Gowell	Toledo, Benton	205	17.29	16.1	4.0	21.3	80.37	345.8	Klein Wanzlebener.
38	P. Cooper	Roseburg, Douglas	1150	13.42	11.5	2.8	16.3	76.19	278.4	Vilmorin Improved.
39	B. F. Collins	Fir, Washington	375	9.95	9.4	2.6	12.6	[illegible]96	199.0	" "
40	G. W. Mitchell	Newburg, Yamhill	975	10.73	9.8	3.2	14.0	76.64	214.6	Klein Wanzlebener. (?)
41	B. F. Collins	Fir, Washington	1145	12.17	11.38	3.2	15.4	[illegible]90	243.4	" "
42	G. W. Mitchel	Newburg, Washington	1115	11.64	10.52	4.5	16.1	[illegible]29	232.8	" "
43	J. C. Johnson	Scappose, Columbia	465	13.74	13.14	3.6	17.3	[illegible]42	274.8	Vilmorin.
44	J. H. Rinck	Buxton, Washington	225	15.61	14.58	4.2	19.8	[illegible]83	312.2	Klein Wanzlebener.
45	W. H. Smith	Roseburg, Douglas	665	10.34	9.12	2.0	12.3	[illegible]64	406.8	Unknown.
46	H. Marks	do do	1230	10.80	10.26	4.2	15.0	[illegible]09	261.0	"
47	John Withers	Lebanon, Linn	187	12.93	11.62	2.6	15.7	[illegible]23	258.6	Vilmorin Improved.
48	John Henry	Beaverton, Washington	480	14.38	12.62	1.8	16.2	86.70	287.6	Redtop.
49	do do	do do	340	13.02	12.14	5.1	18.2	71.53	260.4	Klein Wanzlebener.
50	College Farm	Corvallis, Benton	475	13.36	12.03	3.4	16.8	71.78	267.2	Vilmorin.
51	do do	do do	509	12.51	11.91	3.1	15.7	79.61	250.2	Klein Wanzlebener.
52	do do	do do	283	12.05	11.52	4.8	16.9	71.30	241.0	Dippe Klein Wanzlebener.
53	do do	do do	170	12.12	11.10	3.9	16.0	75.75	242.4	" " "
54	do do	do do	155	12.82	11.68	3.8	16.7	76.75	256.4	Lane's Imperial.
55	do do	do do	225	12.42	11.18	3.4	15.9	78.11	248.4	Vilmorin.
56	Samuel Howard.	Eugene, Lane	1300	13.00	11.97	3.9	17.0	76.47	260.0	Unknown.
57	do do	do do	1011	11.30	9.81	4.1	15.4	73.37	226.0	"
58	R. Scott	Milwaukie, Clackamas	1213	12.82	12.91	2.98	16.8	82.26	276.4	Klein Wanzlebener
59	do do		200	12.18	11.66	4.2	16.4	74.26	243.6	" "
60	T. Pavey	Yaquina, Benton	850	16.23	14.43	2.6	18.9	85.82	224.6	Unknown.
61	F. Terpenning	Eugene, Lane	865	14.15	13.76	3.1	17.3	81.79	183.0	Klein wanzlebener.
62	do	" "	1880	14.41	13.58	3.3	18.0	80.55	288.2	" "
63	do	" "	550	15.18	13.74	1.9	17.0	89.29	303.6	" "
64	M. H. Harlow	" "	1700	12.88	12.38	3.2	16.1	80.00	757.6	" "
65	do	" "	930	15.36	14.20	2.8	18.2	84.39	307.2	" "
66	do	" "	340	17.61	15.74	2.0	19.6	89.84	352.2	" "
67	do	" "	575	14.82	13.09	2.7	17.6	84.20	296.4	" "
68	W. W. Crow	Lorane, Lane	682	11.30	10.22	4.7	16.0	76.62	226.0	Dippe Klein Wanzlebener.
69	J. H. Crow	" "	215	15.69	14.23	2.7	18.4	90.70	313.8	" "
70	C. J. Bishop	Tidewater, Benton	875	13.42	12.24	3.3	16.8	79.88	268.4	Klein Wanzlebener.
71	W. R. Wise	New Bridge, Union	1150	13.95	12.67	4.1	18.0	77.50	279.0	" "
72	J. H. Rosebrook	Toledo, Benton	450	13.68	12.16	4.7	18.4	74.34	273.6	Dippe Klein Wanzlebener.
73	do	" "	460	13.42	11.92	3.8	17.3	77.57	268.0	
74	C. J. Bishop	Tidewater, Benton	927	14.68	13.95	3.9	18.6	78.82	293.6	Vilmorin.
75	John Gage	Stafford, Clackamas	720	16.05	15.07	5.3	22.4	71.65	321.0	Klein Wanzlebener.
76	do	" "	875	13.42	12.14	4.7	18.2	73.73	268.4	" "
77	C. J. Bishop	Tidewater, Benton	412	15.57	14.85	2.4	18.0	86.00	311.4	Bulteau Desprez.
78	do	" "	405	14 17	13.12	2.3	16.6	84.75	283.4	" "
79	James Wilkinson	Beaver Creek Benton	1075	12.55	11.59	4.6	17.3	72.54	251.0	Unknown.
80	Albert Brown	Philomath, "	825	12.03	11.23	4.3	16.4	73.35	240.6	"

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Table of Analysis of Sugar Beets, 1891-1893.

	GROWER.	LOCALITY. POST OFFICE & COUNTY.	Weight in Grams.	SUGAR. Sugar in Juice.	Sugar in Beet.	Solids not Sugar.	Brix.	Purity.	Pounds Sugar per Ton.	VARIETY OF BEET.
81	J. H. Rinck	Buxton, Washington	305	15.71	14.38	6.2	22.0	71.40	314.2	Klein Wanzlebener.
82	do	do do	250	18.80	16.09	3.0	20.9	89.94	376.0	" "
83	Edw. Albright	Ashland, Jackson	325	20.56	19 30	3.1	24.7	87.21	411.2	" "
84	do	do do	255	22.24	20.99	3.2	25.5	79.88	287.6	" "
85	G. H. Baber	Forest Grove, Washington	830	14.38	13.08	3.6	18.0	76.94	292.4	
86	J. G. Stevenson	Eugene, Lane	495	14.62	13.25	4.3	19.0	58.68	151.4	Vilmorin Improved.
87	do	do do	475	7.57	5.88	5.3	12.9	70.87	226.8	" "
88	J. B. Riddle	Riddle, Douglas	865	11.34	10.48	4.6	16.0	68.04	241.0	Klein Wanzlebener.
89	do	do do	1010	12.05	11.93	4.6	17.7	83.01	380.0	" "
90	W. E. Smith	Vale, Malheur	350	19.00	17 69	2.8	22.9	81.98	272.2	" "
91	O. P. Coshow	Brownsville, Linn	450	13.61	11.58	3.0	16.6	72.16	226.6	Unknown.
92	do	do do	950	11.33	10.53	4.3	15.7	72.16	397.4	"
93	do	do do	750	9.87	8.48	1.7	11.6	85.08	200.0	"
94	do	do do	600	10.00	8.98	2.7	12.8	76.12	304.8	"
95	A. N. Ault	Forest Grove, Washington	375	15.24	15.00	6.0	21.3	71.54	266.0	Vilmorin Improved.
96	E. V. Meissner	Kebyville, Josephine	393	16.00	15.20	5.5	21.5	74.41	320.0	Early Rose.
97	A. J. Thompson	Oswego, Clackamas	325	15.20	14.40	2.3	17.5	86.85	314.0	" "
98	J. J. Odale	Union, Union	405	16.10	15.20	1.6	17.7	90.95	332.0	Klein Wanzlebener.
99	A. J. Goodbrod	do do	817	23.00	21.90	3.9	26.9	85.50	460.0	" "
100	College Farm	Corvallis, Benton	2468	12.60	11.90	1.8	14.4	90.95	252.0	" "
101	do do	do do	2900	11.20	10.60	2.0	12.6	88.80	224.0	Vilmorin.
102	do do	do do	3326	15.50	14.70	2.2	17.7	87.50	301.0	White Imperial.
103	do do	do do	4526	13.90	13.20	1.8	15.0	92.60	278.0	Early Rose.
104	S. P. Reeder	Greenville, Washington	532	18.20	17.30	3.8	22.0	78.68	374.0	White Imperial.
105	College Farm	Corvallis, Benton	270	12.70	12.00	2.7	14 7	86.53	254.0	Klein Wanzlebener.
106	do do	do do	300	12.60	12.00	1.4	14.0	90.00	252.0	Vilmorin.
107	do do	do do	303	13.90	13.10	1.8	15.7	89.10	278.0	White Imperial.
108	do do	do do	305	10.00	9.50	1.7	11.7	85.88	200.0	Early Rose.
109	T. E. Hills	Ashland, Jackson	783	15.00	14.20	2.7	17.7	84.74	300.0	Desprez Early Rose.
110	J. M. Hirsh	Union, Union	605	17.00	16.20	1.5	18.5	93.40	340.0	Unknown.
111	College Farm	Corvallis, Benton	340	11.00	10.40	3.2	14.2	77.40	220.0	Klein Wanzlebener.
112	do do	do do	490	9.80	9.30	3.1	12.9	76.29	196.0	Vilmorin.
113	do do	do do	263	11.40	10.80	1.2	12.6	90.46	228.0	White Imperial.

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114	College Farm	Corvallis, Benton	296	13.70	13.10	1.7	15.4	88.97	274.0	Early Rose.
115	H. Buxton	Forest Grove, Washington	1970	11.90	11.30	2.1	14.0	85.00	238.0	" "
116	do do	do do	525	13.10	12.40	3.0	16.1	81.42	262.0	" "
117	do do	do do	1045	14.30	13.60	1.8	16.1	88.80	286.0	" "
118	T. R. Cornelius	Cornelius, do	567	12.00	11.40	3.0	15.0	80.00	240.0	Desprez Early Rose.
119	Geo. R. Woodruff	Philomath, Benton	620	9.40	8.90	2.1	11.5	87.70	188.0	Early Rose.
120	do	do do	640	12.90	12.30	2.8	15.7	82.17	258.0	Vilmorin.
121	do	do do	776	11.90	11.20	2.6	14.5	82 17	238.0	Klein Wanzlebener.
122	M. P. Jones	Perrydale, Polk	1022	13.40	12.70	1.4	24.8	54.10	268.0	Vilmorin.
123	W. C. Tower	Oakland, Douglas	1938	20.60	19.60	3.7	24.3	84.32	412.0	White Imperial.
124	J. D. Rowell	Scholl's Ferry, Washington	341	19.00	18.00	9.0	28.0	67.80	380.0	Klein Wanzlebener.
125	College Farm	Corvallis, Benton	375	.....	.....	....	....	.....	.....	Early Rose.
126	do do	do do	367	14.40	13.50	2.4	16.8	85.70	288.0	Klein Wanzlebener.
127	do do	do do	250	16.70	15.80	2.2	18.9	88.30	234.0	White Imperial.
128	B. D. Dyer	Myrtle Creek, Douglas	291	11.30	10.80	3.0	14.3	79.02	226.0	.....
129	B. E. Cartwright	Eugene, Lane	568	15.10	14.30	2.9	18.0	83.09	302.0	Desprez Early Rose.
130	Michael Lemmer	Roseburg, Douglas	458	15.00	14.20	1.6	16.6	73.40	300.0	Klein Wanzlebener.
131	O. P. Pointer	Hillsboro, Washington	538	14.70	14.00	6.0	20.7	71.80	294.0	White Imperial.
132	M. Snyder	Plainview, Linn	617	17.10	16.20	6.1	23.3	73.40	342.0	Early Rose
133	J. D. Leonard	Ballston, Polk	750	18.70	17.70	5.7	24.4	76.60	374.0	Klein Wanzlebener.
134	Jas. Edson	Carlton, Washington	1416	19.30	18.20	5.7	25.0	77.20	386.0	White Imperial.
135	S. W. Gaines	Hubbard, Marion	558	14.60	14.00	6.7	21.3	68.50	292.0	.....
136	M. O. Lownsdale	Lafayette, Yamhill	980	14.00	13.30	3.0	17.0	82.90	280.0	Early Rose.
137	do	do do	1050	12.50	12.00	3.4	15.9	78.60	250.0	Klein Wanzlebener.
138	C. J. Bishop	Tidewater, Benton	860	14.20	13.40	2.5	16.7	85.00	288.0	Early Rose.
139	M. J. Duffy	Cove, Union	676	21.50	20.40	2.9	24 4	88.10	430.0	.....
140	R. S. Reede	Creswell, Lane	660	15.30	14.40	2.7	18.0	85.00	306.0	Vilmorin.
141	B. C. Hawley	Logan, Clackamas	352	15.10	14.30	1.9	17.0	88.80	302.0	Klein Wanzlebener.
142	J. K. Simpson	North Yamhill, Yamhill	351	14.80	14.10	2.2	17.0	87.00	296.0	Desprez Early Rose.
143	B. F. Church	Monmouth, Polk	770	15.40	14.40	1.6	17.0	90.58	308.0	Vilmorin.
144	W. E. Smith	Vale, Malheur	570	20.20	19.10	3.6	23.8	84.90	404.0	Desprez Early Rose.
145	C. D. Nain	Ballston, Polk	1623	14.00	13.30	4.6	18.6	74.20	280.0	White Imperial.
146	J. H. Rinck	Buxton, Washington	165	17.70	16.80	4.1	21.8	76.60	354.0	Klein Wanzlebener.
147	Wm. Bogue	Toledo, Benton	873	15.00	14.20	3.6	18.6	80.60	300.0	Early Rose.
148	Z. W. Beatty	Chemawa. Marion	840	13.00	12.30	3.1	16.1	80.70	260.0	Vilmorin.
149	R. S. Barclay	Tidewater, Benton	210	19.40	18.40	3.5	22.9	83.40	388.0	White Imperial.
150	C. C. Stanley	Imbler, Union	310	23.80	22.60	2.1	25.9	91.90	476.0	Desprez Early Rose.
151	John End	Warmic, Wasco	330	21.10	20.00	2.2	23.3	90.50	422.0	Early Rose.
152	E. F. Meissner	Kebyville, Josephine	400	15.40	14.60	2.1	17.5	88.00	308.0	Desprez Early Rose.
153	J. H. Bard	Oakland, Douglas	623	14.50	13.70	4.1	18.6	77.90	290.0	White Imperial.
154	do	do do	843	16.10	15.30	5.1	21.2	75.90	322.0	Unknown.
155	P. J. Bond	Peel, Douglas	225	14.10	13.40	1.8	15.9	88.61	282.0	"
156	do	do do	246	21.50	20.40	2.4	23.9	85.77	430.0	Klein Wanzlebener.
157	J. E. Reynolds	La Grande, Union	633	20.90	19.80	2.4	23.3	85.42	418.0	Desprez Early Rose.
158	Robt. Deal	do do	236	16.20	15.30	6.1	22.3	76.04	324.0	Early Rose.
159	F. Clairhorn	Oakland, Douglas	323	13.50	12.80	3.1	16.4	82.30	270.0	Vilmorin.
160	W. H. Norcross	Central Point, Douglas	803	10.90	10.30	2.2	13.1	83.20	218.0	White Imperial.
161	A. H. Sampson	Lewisville, Polk	930	11.30	10.70	4.6	15.9	71.00	226.0	Vilmorin.

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Analyses of Oregon grown Sugar Beets made by the Department of Agriculture at Washington, D. C. *

GROWER	COUNTY.	Weight in grams	SUGAR IN Juice.	SUGAR IN Beet.	Purity.	Solids.	Yield per acre tons.	VARIETY.
Herman Benke	Benton	370	13.88	13.18	79.3	17.49	.....	German.
J. J. Nye	"	355	13.30	12.65	78.4	16.97	7.5	"
C. J. Bishop	"	335	15.40	14.63	87.5	17.61	16.6	Bulteau Desprez.
G. H. Rosebrook	"	300	14.05	13.35	83.1	16.89	6.5	Klein Wanzlebener.
Henry Delinger Jr	"	1589	15.05	14.30	85.4	17.64	25.9	.....
Average		628	14.34	13.71	82.8	17.32	14.12	
Thos. Daniels	Clackamas	500	19.88	18.88	87 6	22.68	16.7	.....
O. P. Yodler	"	105	14.55	13.82	86.5	16.83	.....	Klein Wanzlebener.
Richard Scott	"	1155	12.25	11.62	77.0	15.91	.....	" "
Average		586	15.56	14.78	84.2	18.47	16.7	" "
Clarence Reed	Columbia	275	16.50	15.67	83.9	19.67	17.0	" "
" "	"	830	15.60	14.82	79 8	19.67	20.0	" "
J. C. Johnson	"	535	13.90	13.21	86.0	16.17	11.5	.....
Average		546	15.30	14.56	81.7	18.50	16.2	
J. M. Perkins	Coos	1030	13 00	12.35	80 8	16 31	.....	Klein Wanzlebener,
Mat Kerrigan	"	600	14.50	13.77	83.8	17.31	.....	Vilmorin.
"	"	830	14 65	13.92	80.5	17.71	.....	Klein Wanzlebener.
John B. Fox	"	975	16 80	15.96	87.0	19.31	.....	.....
T. T. Smith	"	865	13.85	13.16	79.1	17.51	.....	Vilmorin Improved.
Average		860	14.56	13.83	82.6	17.63	.....	
W. L. Tower	Douglas	340	17.74	16.85	84.3	21.03	.....	German.
Edward Albright	Jackson	570	18.94	17.99	83.9	22.57	17.8	.....
J. G. Stevenson	Lane	115	12.15	11.54	77.5	15.67	6.5	Vilmorin Improved.
W. N. Crow	"	595	14.05	13.36	77.7	18.09	.....	.....
H. L. Perkins	"	475	13.95	13 25	81.2	17.17	.....	.....
J. H. Crow	"	230	17.50	16.63	84.6	20.68	11.8	.....
C. J. Dodd	"	815	15.10	14.35	83.9	17.99	.....	French.
L. Martin	"	1100	12.67	12.05	82.5	15.35	.....	.....
Average		550	14.24	13.53	85.4	17.49	9.2	.....
John Wither	Linn	180	14.15	13.42	79.5	17.81	.....	.....
Jacob Raber	Marion	1365	12.35	11.73	76.2	16.17	.....	.....
J. Voorhees	"	560	14.45	13.73	85.7	16.87	20.3	.....
Average		962	13.40	12.73	81.1	16.52	20.3	.....
James Douglas	Polk	880	12.10	11.50	79.8	15.17	.....	German.
J. E. David	Sherman	435	13.55	12.86	72.2	18.77	.....	.....
J. H. Logan	Umatilla	395	15.12	14.36	80.9	18.69	.....	French.
W. R. Wise	Union	980	14.10	13.40	81.0	17.39	.....	.....
" "	"	1130	14.55	13.82	82.6	17.59	.....	.....
Average		1055	14.32	13 61	81.8	17.49	.....	.....
J. H. Rinck	Washington	250	12.67	12.04	85.8	14.77	12.8	Klein Wanzlebener.
A. N. Ault	"	430	15.00	14.25	82 0	18.29	15.2	Vilmorin.
"	"	1365	9.80	9.31	68.3	14.38	18.3	"
Average		681	12.49	11 86	80.7	15.48	15.4	.....
Average for State		644	14.57	13.84	82.2	17.72	15.6	

*Compiled from Bulletin No. 33, U. S. Department of Agriculture.

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Oregon Agricultural Experiment Station

Bulletin No. 24. March, 1893.

AGRICULTURE.

1.--POTATOES.
2.--ROOTS.

H. T. FRENCH,
Agriculturist.

C. D. THOMPSON.
Foreman of Farm.

The Bulletins of this Station are sent free of cost to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE.
H. R. CLARK, Manager,
CORVALLIS, OREGON:
1893.

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POTATOES.

Potatoes were grown on the experimental grounds last season, in small plats to determine the character of growth, and adaptability to climate and soil; and in larger plats that a test of the yield might be made.

Seventy-one varieties were grown in small plats of from twenty to fifty hills each, and fifty-nine varieties in plats occupying one fortieth of an acre.

The soil, in which the potatoes were grown, is a clay loam. It is a soil, which is common in the Willamette Valley, occupying the higher portions of the land bordering on the white land.

Wheat was grown on the land the year before, producing a yield of thirty bushels per acre. After securing the wheat, the soil was given a good coating of barn-yard manure. This was plowed under as deep as possible during the winter. The land was again plowed six inches deep in spring just before planting. In addition to the plowing, the soil was thoroughly worked with a Clark cutaway harrow and a spring tooth harrow.

Too much stress can not be placed upon working soil thoroughly before planting. This is true in preparing soil for all crops, and especially is it true of potatoes, which require more moisture than some of the narrow leaved plants. The potato does not send its roots as far, in search of moisture as the corn plant; hence the surrounding moisture must be conserved in every possible way.

In the Willamette Valley, if the soil is thoroughly worked to a good depth before planting, there is little to fear from the dryness of the season.

The ground was further prepared by marking one way with rows 3 feet apart, and with furrows the other way the same distance apart making the rows three feet each way. The furrows were made with the shovel plow to the depth of six inches.

The seed was cut leaving two to three eyes on each piece. One piece was droped in each hill, and was covered with a hoe, so that the hill was a little above the surrounding ground. Deep covering will many times prevent the seed from becoming dried up before it germinates.

Unleached hard wood ashes, at the rate of 600 pounds per

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per 60 lb. box; and 5 cents per lb in bricks, any quantity. A qualitative analysis of this agent by Prof. Lotz, our Station Chemist, shows that it contains lime, sulphur, and salt, or more exactly Calcic hydrate, Sodic Chloride, Calcic Sulphide and Sodic Sulphide. It was reported to contain no arsenic. The proportions used in this experiment were 1 lb IXL, 1 lb whale oil soap, 6 gals. water. As mentioned above the soap is used to cause the liquid to spread smoothly and evenly over the fruit, a very necessary thing.

The recipe given by the manufacturers of IXL for the codling moth, and we have experimented with this also, is similar, but the soap is omitted. The effect of either of these mixtures is not so good as the compound used in

Exp. No. 4 IXL and Paris Green and Soap.—1 lb. IXL to every 16 gals. of water, and to this paris green added in the proportions of 1 lb. to every 300 gals. of liquid. About 15 lbs. of whale oil soap (we believe soft soap would have been as efficacious) were added to this 300 gals. The IXL was crushed to pieces about the size of a hen's egg and sufficient hot water poured on to cover it. It was then added to the water, as well as the soap, *which latter has first been thoroughly dissolved.* The paris green was then added and *the mixture kept stirred when spraying.* We have always found it expedient to mix the paris green with a small amount of water first (if it is of good quality it will readily mix) and then pour the creamy mass into our spraying liquid.

Two lots of trees were treated with this, one receiving the first spraying May 26th another June 15th. Both lots made a very good showing. those last sprayed appearing as well at the end of the season as the former. The cost of labor and material in this experiment was 7 cents per tree (35–40 years old) for each spraying.

OBSERVATIONS ON THE LIFE HISTORY OF THE MOTH. MISCELLANEOUS NOTES, ETC.

A diligent study has been made of the length of time occupied in the different stages of the life of the codling moth. In the Fall of 1891 a breeding-cage was placed out-of-doors, in a situation where it could have, as nearly as possible, the same natural conditions, as regards temperature and moisture, as the insect would be subjected to during the winter in its natural habitat. In this cage several cocoons were placed.

From May 16th to May 26th, 1892, moths emerged from these cocoons very rapidly. From these, from specimens subsequently secured, and from observations in the field, the following data have been conclusively determined: *Life of moth 10 to 15 days, pairing and egg laying taking place during the latter part of that time, after which the moths die.* The eggs are semi-transparent cloudy white with yellowish tinge, the shell finely sculptured (see Fig. 1 Plate 1) from 1-fifteenth to 1-twentieth inches in diameter, and are plastered on the surface of the apple. Each female moth lays a large number of eggs, but apparently only a certain proportion of these eggs develop, as many were found flattened and dead, looking like small trout scales on sound apples. *The eggs hatch in from 5 to 10 days.* The larvæ when first hatched are hardly a twentieth of an inch long, and, in the cases

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under observation, broke or ate their way through the shell, and entered the apple somewhere else than at the spot occupied by the egg. I cannot say however that they do *not* eat *directly into the apple without breaking the shell.* The life of the larvæ in the apple lasts for *about 4 weeks, or a little less*, at the *expiration of which time, they leave the apple and remain in the pupa state three weeks*, when they emerge as moths ready to repeat their destructive work. The last brood in the Fall, however, do not leave the cocoon until spring, remaining as larvæ in their silken nests throughout the winter. It is a noteworthy fact that the eggs of the first brood are not necessarily laid in the calyx end of the young fruit, as eggs were found the past season, (June 28,) long before any wormy apples appeared, and hence belonging to first brood, *placed on both the sides and the top of the fruit.*

The data above cited should be convincing proofs that the moth is at least four brooded in Oregon. To make this still clearer the above facts are embodied below in a table easily understood.

In order, however, that there may be no room for question we will place the date of the appearance of the first moths on June 1st, at about which time we noticed moths in the orchard, four days after their appearance in the feeding cage. The columns are lettered A. B. C. D. E. Series A is continued under C. Series B represents a number of moths which Mr. Coote brought us from his apple room June 20th.* Series B is continued under D, and C, which is continued from A, is concluded under E.

	A	B	C	D	E
Moths emerge from cocoons.....	June 1	June 20	Aug. 9	Aug. 28	Oct. 17
Egg laying (when moths are about 10 days old.)	June 1 /	June 30	Aug. 19	Sept. 7	Oct. 27
Hatching of eggs (5–10 days.)	June 21	July 10	Aug. 29	Sept 17	Nov. 6
Life of larvæ in apple (4 weeks.)	July 19	Aug. 7	Sept. 26	Oct. 15	Dec. 4
End of larvl and pupal stages in cocoon (3 weeks) and emergence of Moths.	Aug. 9	Aug. 28	Oct. 17	Nov. 5 or the following spring.	Emerge the following spring.

The extreme length of the different periods has been used in the table, in order to show how easily four broods can appear during our long warm season. These broods by no means appear with regularity, but there are evidently many individual variations; some eggs hatch more quickly than others, some larvae mature more rapidly than their fellows, or some eggs may be laid a few days earlier or later, according to circumstances. It is evident that there is, consequently, considerable irregularity in the appearance of the moths. But the data upon which the above table is constructed are correct, and the dates given are as nearly exact as circumstances allow.

As to the larvæ which leave the apples about Oct. 15th, it cannot be said with certainty whether they all emerge from the pupa stage Nov. 5th or live in their cocoons as larvae during the winter, passing through their

* All apples had been removed from this room in January; the moths, therefore, which had pupated in cracks in the floor, were from a late brood of the preceeding season. They were unworn and apparently just emerged from pupa cases.

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transformations in fruit houses and store rooms. The finding of a moth out-of-doors as late as Nov. 15th indicates that some, at least, pass through their transformation in the Fall.

There is no question but that the larvæ which enter the pupa stage Sept. 26th (column C) transform into moths the same season, and begin a life cycle which is completed where the apples are stored. Boxes and fruit houses which have contained unsprayed apples, if carefully examined toward spring will disclose, in cracks and crevices, hundreds of cocoons containing larvæ. That there is a marked overlapping of broods in the Autumn, an increasing abundance of the pest and a consequent serious damage to fruit at this time is shown by the finding of apples in Sept. and Oct. with full grown larvae, larvae a week or less old, and others of inter mediate ages. This same discrepancy in ages of larvæ has been observed earlier in the season, all indicating the irregularity of the appearance of the moths and the variation in time required by the eggs to hatch etc.

The first brood of moths here, those earliest on wing, do not appear to affect the pears. This same thing has been observed in some of the Eastern States.

Sept. 18 1892, an egg, apparently fresh laid, found on Duchess pear.

Shortly before, upon, and a few days after Oct. 18, cocoons were found under bands on trees containing larvae which did not change to the pupa stage while under examination, evidently destined not to complete their transformation until the following Spring.

A few apples upon which occurred eggs were allowed to remain a few moments in the IXL, paris green and soap solution, but subquently these eggs hatched. This would seem to indicate that the solution deos not affect the egg itself, but cannot be regarded as conclusive. The young larvae, in the cases observed, invariably left the shell as stated before, entering the apple at some other point. If such is always the case, they are, in properly sprayed apples, certain to get some of the poison.

In some instances an egg or eggs were found on apples in which imma ture larvae had already been found. There would be, then, later, two or more larvae in one apple at the same time.

We have just tested some whale oil soap made by the Arctic Oil works and for sale by The Blumaur Frank Drug Co., Portland, at 7 cents per lb in small lots. We find it to be 80 per cent soap, dark and firm and presume it might be purchased for a little less if obtained in large quantities.

We have used at the Station a soap sold by the old firm of Taylor Nasen and Co., San Francisco, for which we pay 3 cents per lb. in 400 lb. lots, and which the manufacturers claim to be pure whale oil soap. It has answered our purpose very well, yet evidently contains more or less water,—it has not the firmness and solidity of the first soap mentioned.

Summarizing.

Observations on the habits of the moth, extending through three years, together with last seasons investigations, have convinced me that orchardists begin spraying altogether too early. The absurdity, as well as the danger to bees, in spraying the bloom, has been clearly demonstrated before

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this, and it is very evident that the first spraying need not be given until quite a time after the bloom has fallen. This theory is borne out by last year's work in which trees sprayed for the first time with IXL and paris green and soap as late as June 15th compared very favorably with those first sprayed May 26th. Had we sprayed last season anytime between June 1st and June 6th we should have regarded it as early enough. Last season was rather backward, yet we shall govern our actions this year by last year's observations, spraying possibly a little earlier or a little later than June 1—6 as circumstances seem to dictate.

Inasmuch as the IXL, paris green and soap gave the best satisfaction last year, apples going three and four weeks between sprayings, we shall try the same thing in the same proportions this season, spraying for the first time as indicated above and allowing three weeks (granting it does not rain heavily immediately after a spraying, when it might be necessary to repeat) to elapse between the first and second and second and third sprayings. To another lot of trees a fourth spraying will be given, four weeks after the third. It is possible that the late apples may need this, but it is believed, if the trees sprayed are at a distance from neglected orchards, or if all orchardists in a neighborhood will co-operate in the good work, that three faithful treatments will bring very good results.

While we are hardly prepared to indorse all that the manufacturers of IXL claim for it, and while this coming season's work may refute entirely the good results obtained last summer, we are inclined to believe as far as we have seen that it is a good agent in the hands of orchardists. The apple scab (*Fusicladium dentriticum*) was less prevalent on trees where IXL was used (though this must not be regarded as conclusive evidence of its effectiveness in that direction) and the branch form of Woolly Aphis was kept completely in check, a little extra time being taken, when spray- for the codling moth, to direct the spray forcibly against the colonies of this pest.

Banding, *i. e.* wrapping a strip of old burlap about the tree has proved a most valuable adjunct to spraying and will be practiced this season; the bands will de examined every five or six days and the larvæ found beneath will be killed.

Pears evidently do not require any spraying until about the time the second brood is on the wing.

From two to three gallons should be enough liquid to spray a tree from 30 to 40 years old, smaller trees requiring less.

This department has found that Paris Green gives the best satisfaction, and the experience of Eastern workers appears to corroborate this, yet many orchardists in Oregon report in favor of London Purple.

Our storerooms and fruithouses are veritable nurseries for this pest, and send out hundreds of volunteers every Spring. This is overcome in some sections by having gauze over the window or windows and catching and killing the moths in their efforts to escape.

If the orchardist is over anxious as to the efficacy of only three spray-

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ings, or thinks his first spraying has not been thorough, he might safely interpose a spraying ten days after the first.

As stated before 7 cents per treatment will cover the expense, both labor and material, of using the above mixture on large trees.

The later we can safely spray for the first time, the less likelihood of interference by rain.

EXPLANATION OF PLATES I AND II.

Fig. 1, Pl. I, is the egg of a Codling Moth, enlarged about 70 diameters. It was made from a photograph of a camera lucida drawing. The egg is nearly ready to hatch and the embryo larva can be seen beneath the shell.

Fig. 2, Pl. I, is a photograph of a few pinned insects, natural size. The two upper left hand specimens are Codling Moths. Many of our farmers have no idea of the size and appearance of this pest. One of these moths is figured with expanded wings, the other with wings folded.

The clear winged, wasp-like looking moth on the right, the last figure on upper line is the imago of the Peach Borer, *Sannania Pacifica* (Riley), whose eggs hatch into the worm we find in our peach, plum, and prune trees.

The first four insects in the lower line are *Hippodamia convergens* (Guer.) or "Lady Birds," beneficial beetles which consume, with the aid of their larvae, hundreds of Woolly Aphis, Hop Lice, Green Aphis etc. The last beetle on the right in the lower line is an injurious form known as 'The 12-spotted Diabrotica" *Diabrotica 12-punctata* (Oliv.) and in size and appearance it looks not unlike the "Lady Birds," but its habits, of course, are entirely different.

DESCRIPTION OF SPRAYING OUTFIT IN USE AT THE STATION.

Plate II illustrates the apparatus with which we spray, A galvanized iron tank capable of holding about 160 gals. is fastened to a frame made of 2×12 plank, which in turn is hooked on to a wagon bed. When it is necessary to use a warm solution, a sheet iron stove is fitted under the tank, its door flush with the rear end. The smoke stack from this runs forward, below tank, out through a hole in the frame at the anterier end, and ends in an upright piece about 5 feet long (not shown in plate).

We use a Beam Pump No. 5 and it gives good satisfaction. Its receiving hose screws onto a faucet leading from the anterior end of tank, and its two pieces of discharge hose are connected with bamboo extensions as shown in cut.

A wooden cover fits tightly on to tank in the centre of which is a wide slit two feet long, through which a paddle is inserted and the liquid kept stirred while being sprayed. A good and cheap improvement on this method of stirring, which we propose to adopt, is to have a series of paddles, hung from the cover, all worked by a lever which the driver could occasionally push back and forth. When not in use this tank fits into a brick furnace, and is used for compounding any insecticide which requires heat. A desirable addition, which we have not yet arranged, is a tackle to hoist the tank, when full, from off the furnace, and to roll it on to wagon bed.

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PLATE I.

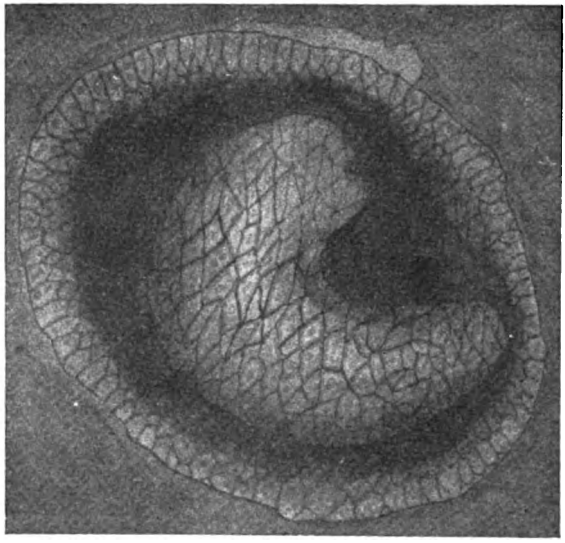


FIG. 1.—Egg of Codling Moth, much enlarged. (Original.)

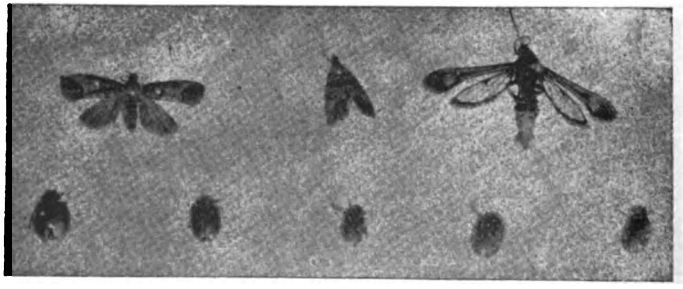
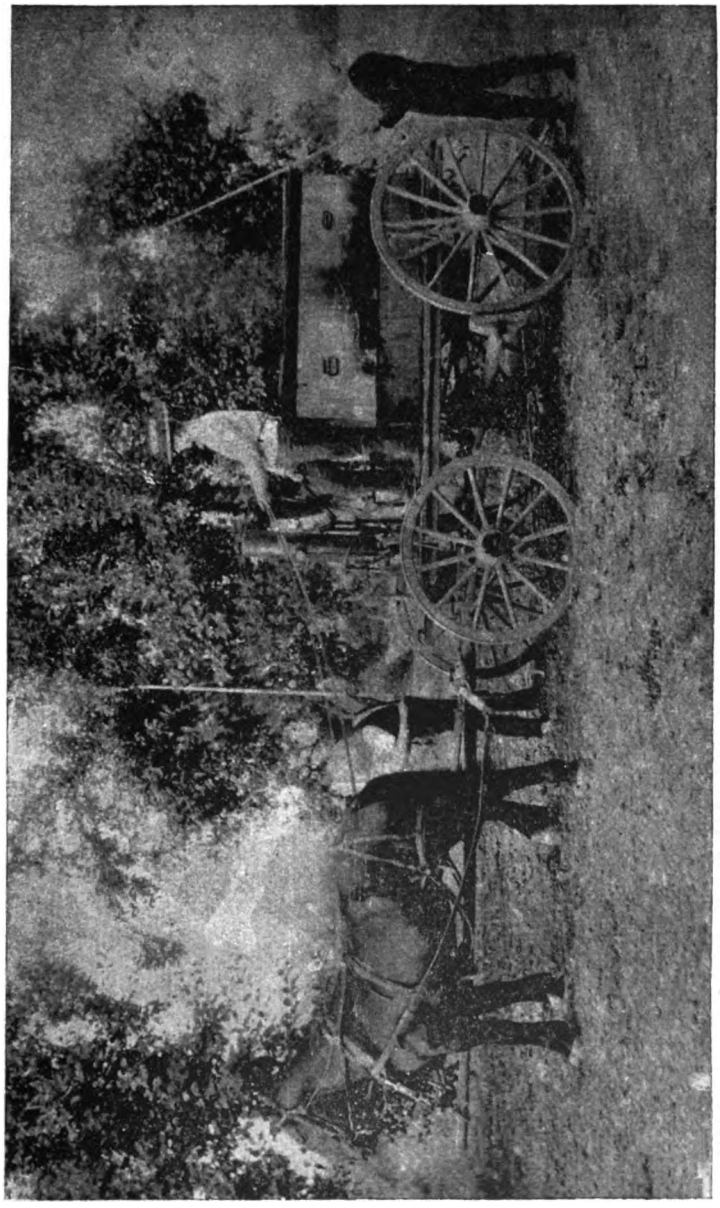


FIG. 2.—A few pinned Insects, natural size.

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PLATE II.



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THE HOP LOUSE.

(*Phorodon humuli.*—Schrank.)

Part of bulletin No. 10 from the experiment station issued in April 1891 was devoted to this subject, giving the life history of the pest, observations on its habits etc. in Oregon, preventive measures and remedies.

Since that was written reports have come from many hop growers of the state corroborating the statement that wild plums, or seedlings, and, in a few instances, a very few,—cultivated plums and prunes were the place of deposit of the eggs which last through the winter and hatch in the spring The migration of the hop louse from plum to hop and hop to plum is not now questioned by observant growers notwithstanding the opposition which this statement met with two years ago.

On p 32 of Bulletin No. 10 methods of prevention and remedies were given, viz. (*a*) clearing away superfluous timber about yards, letting in sun and breeze; (*b*) cutting and burning all thickets of plum seedlings, wild plums etc. in the vicinity of hop yards; (*c*) avoiding importation of eggs on plum scions from localities infested with hop louse; (*d*) cutting and burning the vines directly after picking; (*e*) spraying, to kill eggs, any valuable plums or prunes upon which eggs occur, with strong caustic solutions, when the buds are dormant; (*f*) spraying the same trees in Spring and Fall while the louse is found thereon, using any of the sprays recommended for Summer treatment against plant lice; (*g*) spraying the hop vines themselves during the summer season with any of the following standard solutions hitherto suggested, viz., Quassia and Soap, Kerosene emulsion, Tobacco and Soap.

Further study of this subject during the two years elapsing since the above was written has brought out some points of especial value to hop growers and the object of this treatise is to present, in a brief form, these new facts. There is no hop yard at the Station or in the near vicinity, and much of this information has been obtained by visiting yards, and talking with growers. Our thanks are due Mr. T. D. Linton, Mr. G. Muecke, Mr. Bents, Mr. Reuben Wright, Mr. S. Smeed, and others for various courtesies.

No reason has been offered for in any way changing the recommendation given under (*a*) above, it being a noticeable fact that hops planted on the uplands are freer from lice than those in river bottoms. We still recommend (*b*) as in a measure, abating the evil, but it should be borne in mind that this insect while in the winged form, may migrate or be carried by the wind a long distance from the hops hence this measure is only part of the work and does not afford complete exemption. No comment is needed on [*c*], its value is apparent. Regarding cutting and burning the vines directly after picking, [*d*] much can be said. The most contradictory reports have been received relative to this practice, which in some places is in general use. Some of our growers claim that if cut high enough [about 3 or 4 feet] and tied at the end, no injurious results follow and others assert that whenever and wherever cut, the crop of the following year is injured and may be a failure. *The weight of testimony appears to be decidedly against cutting, even when lifting out the poles*, careful workers asserting that the

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pole can be rotated in such a way that it can be slipped np through the coiled vines, only necessitating the possible cutting of one or two stems. Further, we are privileged to illustrate and describe a method of trellising a yard which does away with the necessity of using poles, and consequently of pulling them up. The burning of vines, immediately after picking is, of course, to kill the lice before they may have migrated to the plum where they pair. It should never be done on the yard, and, if the measures recommended elsewhere for summer use, are carefully carried out, it may be postponed to suit the convenience of the grower.

The propositions [*e*] and [*f*] need no comment, they hold good anywhere and their use is regulated by the judgement of the growers. Spraying the hop vines themselves during the summer season [*g*] is the only true resource of the hop grower and all progressive hop men unite in saying that they regard spraying their hops as much a necessity as their cultivation and that in estimating their year's expenses, the cost of spraying is always included. All other preventives catalogued are of little value if the grower thinks he can thereby avoid spraying the vines during the summer. They may alleviate the evil to some extent, but it would be folly to rely upon them alone.

Granted then that spraying the vines during the summer is a necessity, and it surely is, the question arises, "what material have our hop growers found most efficient"?

Kerosene emulsion was one of the spraying solutions recommended in Bulletin No. 10; it has been used in the East on hops and to some extent on this coast, and is one of our most efficacious insecticides for plant lice. Kerosene however, as the reader knows, is fatal to vegetation, and to properly compound the emulsion requires great care. Its efficacy depends so largely on its proper manufacture, and there are so many chances for an unprofessional to make a disastrous error in its preparation and use, that growers, in view of safer compounds, should be cautioned against it. It should not be used when hops are in bur. Conversation and correspondence with very many growers lead us to say it is *not a safe insecticide in the hands of our hop growers.*

Quassia and Soap.—This is highly spoken of, and barring the expense of the chips and the time consumed in extracting, is recommended. Quassia chips are for sale by parties here and in the State of Washington for about 6 cents per lb. Whale oil soap can be obtained in bulk from 3 cents per lb. to 6 cents or 7 cents per lb., the latter guaranteed to be 80 per cent strength.

Tobacco [*stems*] *and Soap.*—This has given such perfect satisfaction, after repeated trials that we unhesitatingly endorse it. Furthermore its cheapness, and the fact that it does not necessarily call for whale-oil soap [though this may be used] but an inexpensive home made soap, makes it a desirable agent. Mr. G. Muecke of Aurora Mills Or., has used it and is delighted with its efficacy. The stems can be used twice and then are valuable as a fertilizer and preventive of grub worms.

The solution should be of such a strength that the liquid has a decided tobacco color. Strain after steeping. Add enough soap [cheap soft soap or

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whale oil soap] to make the liquid spread evenly over the leaves. Mr. M. states that in England tobacco is recognized as better than qnassia in this direction, but that there tobacco is more expensive; here the tobacco is the cheaper of the two.

Two cents per lb., is charged at factory in Corvallis for waste tobacco stems, and presumably the price is the same elsewhere.

The supply from these sources is limited and Mr. Muecke has agreed to sell tobacco stems [gathered up from various sources in San Francisco] for 3½ cents per lb., as long as the supply in his storehouse lasts. This figure, which covers the cost of transportation from San Francisco to Aurora Mills. is nominal compared to the cost of quassia.

Wm. Brown of Salem sells quassia chips made here from quassia logs shipped from New York, for 6 cents per lb., and whale oil soap which he guarantees to be 80 per cent., for 6 cents per lb. He is also agent for the Roberts' Roller Sprayer.

Regarding apparatus for spraying, the growers must be guided by their preferences. The Bean Pump, maunfactured by the Bean Spray Pump Co. at San Jose California is highly spoken of, and the experiment station can indorse this pump for general use. The Mitchell Lewis & Staver Co are agents for this pump, the difierent sizes selling all the way from $16.00, to $54.00, In California the Champion Spray Pump also meets with approval sold by Woodin & Little S. F.

The Puyallup Roller Sprayer sold by Meeker & Co. of Puyallup Washington, and the Roberts Sprayer made by Roberts of the same place, both working by horse power, are advertised. We cannot, at this date. speak of their comparative merits.

MISCELLANEOUS NOTES.

Young lice on the lower surface of leaves if exposed to the rays of a hot sun, quickly die. A number of growers taking advantage of this, pick the lower leaves when first infested and leave them on the ground, *their undersides uppermost.*

A number of prominent growers report very favvrably on the use of sheep in the hop yard. They must be removed as soon as they have eaten the lower leaves and begin to paw the poles in their efforts to reach the foliage above them. If they are not disposed to eat hop leaves at first, one grower suggested picking a few leaves, sprinkling them with a little salt water, and then feeding. The sheep soon acquire a fondness for the natural leaf.

The time for the first spraying is when the lice first appear in the yard. Growers should, therefore, watch the vines for the first evidences of the presence of the pest.

In no instance has a genuine hop louse been sent to the Station from any other plant than a hop or plum or prune tree except a few sent by S. A. Clarke of Salem on mint leaves. This mint however grew among plum or prune trees which were infested, and the occurence on the mint may ave been accidental.

Hop lice which were found on Petite prune' have been sent to this department in a few instances. The Italian prune has not been touched as far

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as is known. The louse does not remain on any plum or prune tree long enough to cause appreciable injury.

Mr. Smeed of Waterville writes that the German Grape and English Cluster have been badly infected. He has three varieties of early hops ripening from 10 days to 2 weeks before the English Cluster. It has never been necessary to spray these, though adjoining infested yards of other varieties.

The following diary memoranda may be of interest:

April 12, 1892.—Many Green Aphis [*A. mali*] sent in from two localities under the impression that they were the hop louse.

May 16.—Genuine hop lice received from T. D. Linton of Eugene found on Blue Plum: Mr. Wells of Buena Vista reports winged hop lice on his hop vines. Specimens were sent, and proved to be *Siphonophora* and not hop lice.

May 18.—Specimens of hop lice received from Capt. Wuestney Napavine Wash., found on an unnamed plum tree.

May 27, 92.—Winged and wingless hop lice received from Salem Or., found on Plum trees.

June 1, 1892.—Specimens of hop louse received from T. D. Linton of Eugene, found on Hop Vines. The above dates indicate the time of migration from plum to hops.

Mr. B. Grimm of Aurora finds IXL in the proportions of 1 lb. to 10 gals of water a good wash for the hop vines. Capt. Wuestney of Napavine Wash. speaks highly of its effect on the vines. He reports unfavorably of the Woodbury Tree Wash. G. Muecke of Aurora also reports unfavorably on Woodbury Tree Wash as far as hops are concerned.

Mr. Alec. Holmes of Derry Or. is reported as finding chittim-wood bark (*Rhamnus*) as good for hop lice as quassia. Another party claims that the vegetable pest known as "Man-in-the-ground" (*Megarrhiza Oregona*) is a good remedy. We have had no opportunity of verifying this.

Too early picking, occasioned by the attacks of vermin, apparently injure the vines. This seems especially true of the German Grape and English Cluster varieties.

Mr. Muecke states that he "sprayed with the tobacco solution up to picking time, and that after the hops were dried and baled various experts could find no trace of tobacco smell."

A TRELLIS FOR HOP VINES.

Through the courtesy of Mr. Reuben Wright of Mulino Or. we are enabled to present the following figure and description of a method of trellising which he has adopted in his yard. The principle is not new, though some of the details may be innovations.

The advantages of this method over the old system of poling are apparent; the growth is more even; at least one third of the spraying material is saved; in picking, the two wires are raised off the pins with a pole, and they then are low enough to pick all the burs, there is thus no need of loosening the ends.

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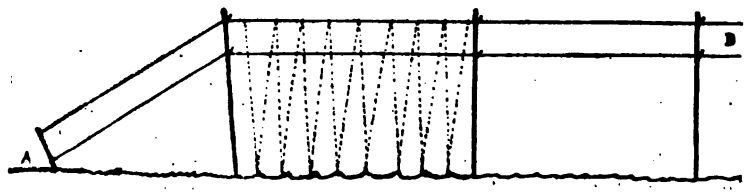


FIG. 3.—A Trellis for Hops.

Explanation of figure:—A is placed on surface of ground and by the side of an anchor post. This anchor post is 6 in. ×6 in. and 7 feet long, 4½ feet of this being below the surface, and it inclines at an angle of 35 degrees. The anchor post is 10 feet from first support and has its counter part at the other end of the row. Supports consisting of cedar, each equal to a 4×4 in size, are placed between the two anchors, nine hills intervening between every two supports (only eight are indicated in the fig.) The support nearest the anchor leans slightly. Each support is 11 ft. long, 2 ft. being below the surface. Six inches from the top of each support a ⅛ in. wooden pin is inserted, slanting enough to hold wire securely.

Thirty inches lower down is a similar pin. As indicated in the figure there are two galvanized iron wires, the upper one size No. 12, the lower No. 13; the letter *B* is placed between the wires. The dotted lines in figure represent common cotton twine, two strings from each hill fastened to the two wires. About five pounds of this twine is used to the acre.

The method of raising the wires and stringing is as follows: the supports and anchors in, and the wires stretched through the yard, a ten penny nail is driven into each support five feet from the ground and another one thirty inches lower down. The wires are then fastened to anchor post at one end, raised to the nails, the upper wire lying on the upper nail, and the lower on the one below. The wires are then pulled as tight as possible and wrapped around the anchor post at the other end. The twine is cut into pieces ten feet long. Two of these pieces are used for each hill (see dotted lines in figure) each piece being passed round bottom wire once and tied firmly to upper wire. After the row is strung raise the wires to the wooden pins, and stretch tight, the tighter the better. A fir splint six inches long is driven into each hill, after the strings are fastened to it, by two half hitches. These strings should be taut from hill to wires. The twine costs 90 cents per acre, No. 13 wire costs $15. per acre. The cost of the timber for anchors and supports and splitting and hauling differs, of course, with circumstances.

Mr. Wright will doubtless be willing to answer any further inquiries regarding this trellis.

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GOPHERS AND MOLES.

"Well said, old mole! cans't work 'i the ground so fast?"

The order of animals known as Rodentia or "gnawers" comprises a very large share of that portion of the class of *Mammalia* which is found in North America. The order is characterized by the presence of chisel-like incisor teeth in the upper and lower jaw with which their gnawing is accomplished. Our rats, mice, squirrels, marmots, rabbits, and gophers are examples of this order and illustrate this dental characteristic.

The Pocket Gophers or Pouched Rats, prominent rodent pests, occur in a family called *Geomyidae* and are widely distributed over the United States. The special individual which occurs in such destructive abundance on this coast, and forms part subject of this sketch is *Thomomys bulbivorus*. Against this pest and against our common mole *Scapanus Townsendii*, which is also so unfortunate as to be regarded in an unfavorable light, this department has worked for the past two years endeavoring to find remedies which would afford, at least, some relief.

The mole does not belong to the same order as the gophers, its habits are different; structurally it is widely different, and its small sharp teeth all much alike, seem especially adapted to crushing and masticating insects, grubs, worms, etc. In fact it belongs to the order *Insectivora* which means "insect eating." The mole's reputation among scientists as a non-vegetarian has been for a long time so firmly established, that any charges of its eating roots or bulbs or seeds has been emphatically denied. This belief in the mole's innocence was entertained by many of our leading workers in this class of animals, and it would seem now, in spite of unfavorable evidence, that, apart from the unsightly mounds on our lawns and the disarrangement of soil in our flower beds, and even admitting his occasional fondness for peas and bulbs, that he cannot be placed in the same category with the pocket gopher, and merits clemency of treatment at our hands. Yet the decree having gone forth that the mole is a pest seals his fate as far as human intention goes and hence we seek for means of killing him.

To return to the Pocket Gopher. Their mounds are familiar to almost every resident of the State.

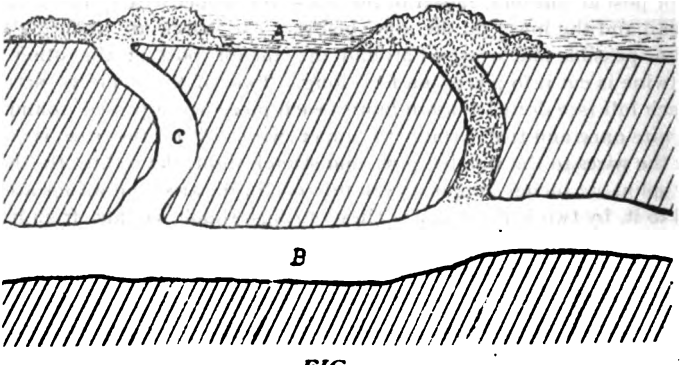


FIG. 4.

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Fig. 4 illustrates, diagrammatically, a burrow of this species. B is the main run way from 12 to 20 inches below the surface A. C is a branch burrow from main runway to surface, affording a means of getting rid of the excavated earth. This branch is represented as still open: to the right is another, which, having served its purpose is plugged with earth, the mound on top marking its location.

The plan of the mole's burrow is exactly the same except that the main runway may not be as deep, and in addition to what is shown in Fig. 4 there frequently is an additional burrow close to the surface, forming that characteristic ridge often seen on our lawns and among our garden plants. Furthermore we have never found a mole's branch burrow open, except where it has been made beneath the snow; upon the melting of the snow the open hole is seen. This characteristic, even if there is no ridge caused by the surface burrow, will at once enable one to tell whether he is troubled with a gopher or mole, for the last made branch burrow of the gopher is often open, and in fact at certain hours in the day the occupant may be seen thrusting his head out, while busily engaged in getting rid of the earth which has accumulated within. This the mole does not do, and althongh we often see his mound moving before our eyes and visibly growing larger, the little depredator is concealed below. His minute bead like eyes, concealed beneath the velvety fur, but present nevertheless (this applies to this particular species, there are forms where the integument covers the rudimentary eye) would be of little service to him above ground; indeed it probably avails him very little in his wanderings below the surface, as his sensitive snout and delicate sense of smell are his chief guides in searching for food. As a rule the mounds of the mole consist of more finely pulverized soil than do those of the gopher, but they may be as large or larger than those of the latter. The burrows of the mole are, of course, smaller than the gopher burrows.

The first figure in Plate III at the end of this article is a male pocket gopher, dorsal view; the second is a female ventral view, and showing on the sides of the head the characteristic pouches (not connected with the mouth) opening below. This depredator often leaves its burrows at night on foraging expeditions and at this and other times when collecting food below ground these pouches are used as pockets in which the food is carried. Some observers state that the earth which is brought up from the main burrow is largely carried in the cheek pouches, while others flatly contradict this, asserting that the soil is pushed ahead of the animal. Both statements may be correct, we have never found any proof that they use the pouches as earth carriers. Both gophers and moles are active here during our winter season. The breeding season of the mole is early in this state, my diary states that on Feb. 28th of last year a pregnant female was captured containing three well developed embryos, and two days later another was captured with two embryos apparently within a few days of birth. I have, as yet, been unable to secure a pregnant gopher and hence cannot speak with accuracy of the exact date of their breeding time, but from the fact that I have caught one meadow mouse (*Arvicola*) Mar. 10 with six nearly

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full grown embryos, and since I have been unable to catch any female gophers at about this date, Feb. 15th to Mar. 15th approximately, I infer that the breeding season, that is for the first litter, is nearly contemporaneous in the three types mentioned. It is very evident that the best time to destroy them, if possible, is early in the season before the birth of the first litter.

The pocket gopher has not a little intelligence. Our horticulturist reports finding a nest stored with potatoes, the tubers lying in layers, and each layer separated from the adjoining layers by more or less dried grass. Furthermore the entrance to this nest, or at least one entrance, was from below, affording a system of drainage quite desirable in this country of wet winters.

It is a common thing to see gopher mounds arranged in a straight line from the side of a field or garden to some fruit tree or potato, parsnip, or carrot patch, indicating that his main burrow beneath the surface has been pushed directly to these sources of food supply.

REMEDIES FOR THE POCKET GOPHER.

Poisoning:—We have introduced powdered strychnine into pieces of potato an inch square and placed this bait down the branch burrow, or even as far in as the main burrow, with fair success. We have never had conclusive evidence that the animals were poisoned, except that digging ceased in that neighborhood which was pretty convincing proof that the strychnine had done its work.

This has proved most effective in the absence of other succulent root crops which may be more tempting to the gopher. And inasmuch as he may push out the bait with a lot of earth, before he fairly reaches it, it has been found best to put into the burrow more than one piece.

It goes without saying that ***stychnine, being a deadly poison, should be kept under lock and key***, out of the way of children and others ignorant of its use.

Wakelee's Poisoned Wheat is claimed by some to be not only efficacious against the so-called "Digger Squirrel" but to be also a good remedy for the pocket gopher. If this is so, it must be at times when other more juicy food is scarce.

Shooting:—A handy shotgun is very effective. The pocket gopher works during the night, and is quite likely to be found digging *early in the morning, again about noon and again late in the afternoon.* At these times he frequently thrusts his head out of his hole and a few pellets of shot will kill him.

But the farmer or the orchardist can not afford to spend time in watching gopher holes, and their best resources are poisons and

Traps:—There are many so-called gopher and mole traps on the market but apparently very few which can be profitably purchased.

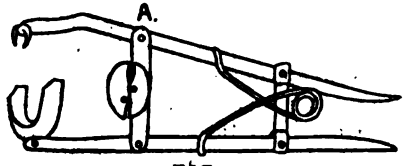


FIG. 5.

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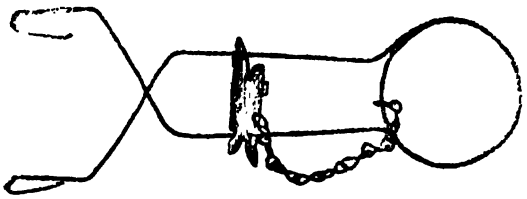


FIG. 6.

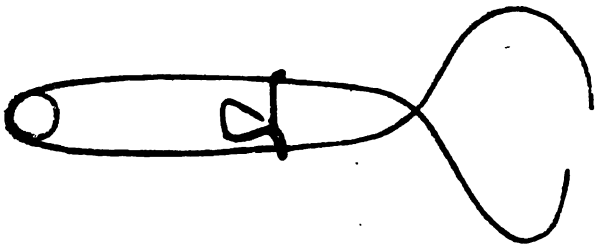


FIG. 7.

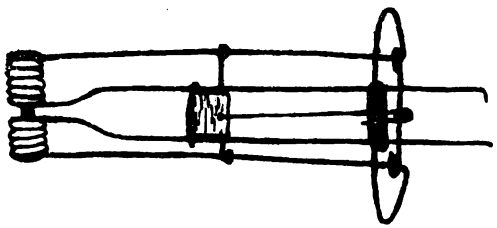


FIG. 8.

Fig. 5 above shows a gopher trap which has been on the market a number of years. Fig. 6, 7, and 8 represent other traps (all set), costing at retail 25 cents each. Specimens of each were donated the station for trial and we have worked with them for two years and find them of little if any value. A few young, undersized gophers have been caught, but it has almost invariably happened that the wily rodent has covered them up with earth, or possibly, in a few instances, left a few hairs on the points (in the case of the trap shown in Fig. 8) showing plainly that the trap is not strong enough.

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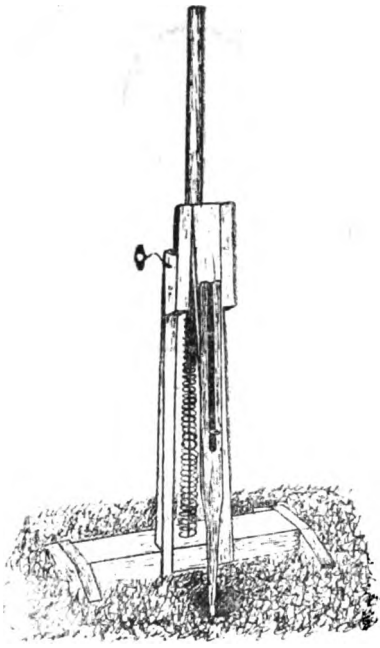


Fig. 9 represents, a trap, which we have found very useful against both gophers and moles. The cut shows the trap set for a gopher. It is made by John Picard, St. Paul Marion Co. Oregon. and this particular trap we purchased from J. B. Mount Newberg Oregon for $2.50. This is too high a price, and the maker could increase his sales ten fold if he would sell them at a more reasonable cost. Numerous letters to Mr. Picard relative to this point elicit no reply whatever and Mr. Mount has recently written us that he has not seen nor heard from the manufacturer, whom we understand is a farmer well known in that locality, for some time.

FIG. 9.—The Picard Gopher and Mole Trap.

DESCRIPTION OF PICARD TRAP AND DIRECTIONS FOR SETTING.

It is about two feet high. Through the base-board runs a brass spear, which is fitted into the lower end of a wooden rod, the latter working up and down in a hole in the top of the trap. A triangular piece of iron (shown attached at one side in cut) serves as a trip bar and when the trap is set keeps the spear up and is lightly caught under a piece of iron on the trigger which latter (see Fig.) swings easily on a hinge. As shown in figure a sliding piece, pointed at the end is attached to the trigger and can be adjusted to any length- The downward pull on the spear is brought about by a strong brass spring as shown.

In setting, a branch burrow which is open is found (C. fig. 4) or one is opened with a trowel, and the spear forced down *perpendicularly* through the soil, about six or eight inches from opening, *so that it passes directly through the center of the burrow. The base must lie squarely on the ground The spear is then worked several times up and down through the soil, that there may be no binding when sprung.* Before setting, the pointed end of the trigger is worked back and forth, to see that the soil does not impede its movements. The point should be within an inch of the bottom of the mouth of burrow.

A stone or heavy clod of earth is then placed on the base on each side to keep trap steady when sprung. The wooden rod is then raised, the trip bar adjusted and the trap is set.

The principle is this: the gopher will sooner or later stop up this branch burrow. Or, seeing the pointed stick at his doorway, he at once proceeds to push out a lot of earth to protect his domicile from what may appear a sus-

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picious object. The earth pressing against the trigger point, springs the trap, and the gopher, behind the earth, is speared.

We have used this trap successfully against both gophers and moles. What failures we have met with have been attributed to not gauging correctly the distance between trigger and point where spear enters burrow. In one instance, when the trap was set in a patch of peas, the gopher pushed against the trigger himself, issuing from his hole to nibble the delicate bait close at hand, and it was not until the above distance had been shortened, that he was captured. One can dig to the main burrow (*B. Fig.*) and set the trap there. But in this case it is generally impossible to tell from which direction the gopher will come, and a second setting may be necessary. By introducing a small bit of wood above the screw between the sliding part of the trigger and its upper part, an angle may be made between these two parts, and the lower point thus brought nearer the course of the spear. It has been found necessary to do this in setting the trap for moles.

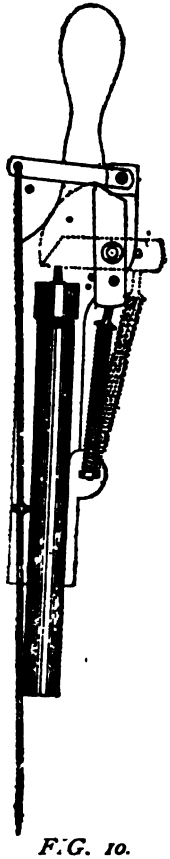


FIG. 10.
Gopher Gun.

Fig. 10 shows another trap which we have used against both gophers and moles with success. It is represented as set. It is very efficacious, and though requiring more care in setting than the Picard trap, there are probably less chances of failure when the details are carefully attended to. This trap is about 16 inches long and no description is necessary. It is of course, a fire-arm, *and as such has to be handled carefully.* It is for sale by O. Dickenson of Salem Oregon for $4.00. He states that he will have the exclusive sale of these traps for the next four years, and that the inventor has applied for a patent. It is needless to say that we regard four dollars as a very high price for this gun. Undoubtedly lessening the price would increase the sales. The agent states that during a single season, with one gun, he has killed nearly a hundred gophers. It is certainly very killing. In setting, the earth should be so hollowed out with a trowel that the muzzle, which is placed 4 or 6 inches down the burrow *lies directly in the middle line, the barrel parallel to the long axis of the burrow; the gun should lie squarely on the ground, and care should be taken to see that the wire plays freely back and forth.* On the point of this wire is firmly placed some object to blunt it, a piece of wood, or small cork, or better, a small piece of carrot, potato or parsnip. *Only a small charge is necessary, a thimble-full of powder, and twenty pellets of No. 3 shot will do very nicely.* A water proof cap is fitted tightly to the nipple, the hammer is drawn back and caught. This applies to the branch burrow, which has either been found open or has been opened with a trowel. It is set in the main burrow in the same way, but, as in the case of the previous trap, there is an uncertainty of the direction of the gopher's approach. The animal, in pushing the earth before him, literally shoots himself.

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Remedies For Moles.

The last two traps described have worked very well with us. When used against moles they are set in the same way as for gophers. The branch burrow of the mole is always closed, that would therefore have to be opened; and as this burrow is shorter than that of the gopher, the muzzle of the gopher gun cannot be thrust down so far, *it projects into the hole only an inch or two*, that the mole (and the same thing applies to the gopher) may be fairly in the branch burrow before the gun is discharged.

In setting the Picard trap for moles the distance between the lower point of the trigger and the point where the spear enters the burrow, *should not exceed four or five inches.* This is effected by the introduction of a small bit of wood, as above described, between the two parts of the trigger.

Poisoning:—At the suggestion of a party who had been experimenting on a mole in confinement, we tried poisoning small pieces of beef with powdered strychnine, opening the burrows, introducing the bait as far as possible with a spoon and then covering with earth again. In a number of cases where this was done, digging ceased, but not in all. It would seem that the scarcity of their natural food, or its abundance, would affect the efficacy of this method.

Other Means of Killing:—When one is so fortunate as to observe the soil of a mole's mound moving, indicating that the depredator is at work below, a well aimed thrust of a fork will frequently be successful in transfixing the hidden animal.

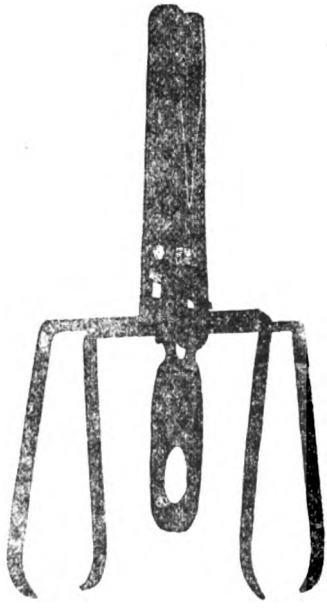


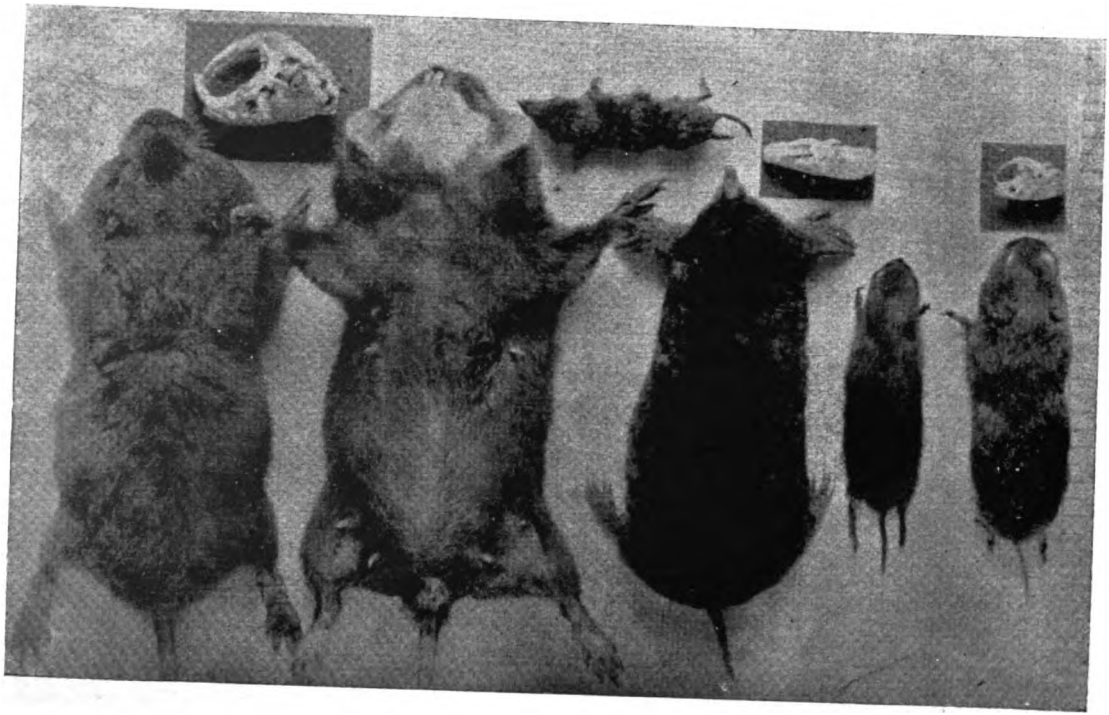
FIG. 11.

Fig. 11 illustrates a trap modelled after an English pattern. It is represented as set. There should be teeth filed in, or soldered to, the inner edge of the jaws, and the steel spring should be very strong. The centre piece, which hangs down between the jaws and keeps them spread apart, is the trigger. Almost any blacksmith can make this trap at little expense, and we believe, with the two improvements above mentioned, which improvements are found on the English trap, that this would be a killing instrument. In setting, the main burrow is cut into and into the cut is inserted the trap in the position indicated in the figure. The opening above, is covered with dried grass or other rubbish to keep out the light. One party reports that he fills in the hole, in which he has placed his trap, with soft earth, and rarely fails to catch the mole as it is digging its way through the yielding obstruction.

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PLATE III.



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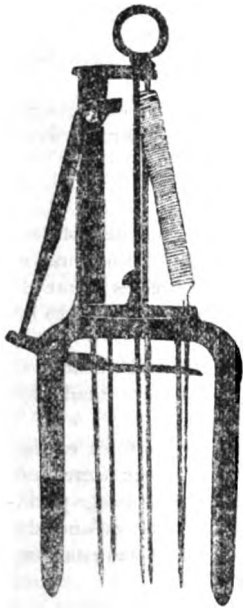


FIG. 12.

Fig. 12 represents a mole trap which is intended to be so set as to spear a mole as it runs through the *surface burrow*. When a newly made ridge is seen, the trap is pressed into the ground in such a way that the two heavy iron pieces on the side straddle the ridge, and the pointed wires project through the burrow. These points are then raised, the ridge slightly flattened beneath them and the plate, which connects with the trigger, lies on top of this flattened surface. The mole in forcing its way through the burrow, raises the plate, springs the trap and receives the pointed wires. We have not tested this trap sufficiently to warrant an expression of opinion upon its merits.

"The California Ground Squirrel." "Digger Squirrel." "Gray Gopher."

Spermophilus beecheyi (Cuv.).

Our wheat crop and fruit trees suffer from this pest which is so well kuown that no description is necessary.

Remedies.—Wheeler's Bisulphide of Carbon is recommended for this rodent. We have not used it.

To prevent "ground squirrels" from gnawing fruit trees, a California orchardist suggests tying newspapers round the tree trunk in such a way that four inches of the paper at the upper edge extends out. The rattling of the paper when the squirrels attempt to cross it will frighten them.

One of the most effective means for their destruction seems to be a trap in successful use in the large orchard belonging to J. H. Stewart at Medford, Or. He places, in fence corners abont his orchard, boxes about one and one half feet square at 'he ends and about four feet long. The top and two ends are united and can be lifted off the box. The ends do not reach quite to the bottom board, an open space of about four inches intervening, [see Fig. 13], and enabling the animal to run through the box and out at the other end. On the bottom, midway between the two ends, peices of pork rind are securely nailed. These peices have been first soaked in a solution of strychnine, made by boiling strychnine in water. Kernels of corn may be steeped in the same solution and placed with the pork as an additional bait, but is more easily displaced and hence more likely to be eaten by some animal for which it is not intended. But the pork rind cannot be

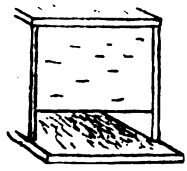


FIG. 13.

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removed. The top is fastened on to the box by means of a couple of nails, which can be easily pulled out when putting in new bait.

Mr. Stewart asserts that his trees are free from all attacks of this pest through using this very simple device.

Strychnine is not very soluble in water, but, if thoroughly boiled, enough will dissolve to make a poison. It would seem that if the solution were sweetened it would render it more palatable.

Notes.

The burrows of moles are sometimes found running in patches of carrots, etc., and the finding of a gnawed root in the course of the burrow would seem to implicate our friend with velvety fur, but a species of meadow mouse [Arvicola] frequently uses this passage way and is believed to be the depredator.

In the spring we suddenly find, in localities, in our fields and meadows, numerous small holes about two inches in diameter. These are made by meadow mice.

A party in Portland Or. who was convinced that moles were eating valuable bulbs, kept three specimens in confinement for some time and fonnd they would eat the following substances: wheat, pears, beef, pork, mutton, and peas. Witnessing one fellow eat the latter quite ravenously was pretty convincing proof to the writer that, under some circumstances, at least, they are not strictly carnivorous.

In this connection we quote from a recent writing of Amos W. Butler of Indiana. Speaking of moles he says, "They generally, if not always, feed upon animal food, insects, grubs, larvæ, earth worms, slugs and almost any sort of animal food appears to be eaten by them. Many suppose them to injure garden vegetables by eating the roots. Such is not thought to be the case usually, however, if at all. They excavate a runway along the row of plants so that they may secure the insects there found, and it is supposed the meadow mice are the forms which utilize the highway thus provided that they may secure a meal of their favorite food from the succulent roots of many plants *I have, however, never been satisfied that the mole, in sandy soil, is not very destructive to young pea sprouts just as they are emerging from the ground.*"

In a number of moles caught in March 1892 the stomach contents consisted almost entirely of finely triturated earthworms, no vegetable matter being present. In one captured in Jan. 93 the stomach contained nothing but a few delicate fibrous roots.

Jack Rabbits, though not belonging under the head of "gophers and moles," are such a pest in parts of Eastern Oregon that they deserve a passing notice.

In some portions shooting them on moonlight nights as they come into the young orchards is practiced.

Pieces of poisoned melon scattered plentifully through an orchard has been found helpful, the rabbits preferring the melon to the bark. Any vegetable of which they are especially fond might be used when melons are lacking. The two following recipes are recommended as making ef-

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fective poisons: Add 9 gals. of water to 100 lbs. of wheat. To this add 1 lb. of phosphorous, 1 lb. of sugar and 1 oz. of oil of rhodium. Bring to a boil and let stand over night. The next morning stir in enough flour to to make a kind of paste. Scatter this over ground frequented by the animals. The second recipe is ½ teaspoonful of powdered strychnine, two tablespoonfuls of fine salt, four tablespoonfuls of granulated sugar. Shake well together in a tin box. If placed on boards this becomes hard and rabbits lick it eagerly.

DESCRIPTION OF PLATE III.

The first figure on left is a male pocket gopher [*Thomomys bulbivorus*] dorsal view. The next figure is a female gopher, ventral view to show opening of pockets on side of head. To the right of the head of this specimen is a small shrew. The shrews are small mice-like animals, shy and retiring in their habits, belonging to the same order as the moles, strictly carnivorous and very pugnacious. They kill and eat many field mice, and not infrequently are given to killing and eating each other.

The large figure to the right of the female gopher is a mole [*Scapanus Townsendii*] and to the right of that two meadow mice belonging to the genus *Arvicola*. The first skull on the left is that of a pocket gopher, the next one that of a mole, and the smaller one on the right that of a field mouse, The picture does not show the difference in dentition between the two orders *Rodentia* and *Insectivora*, for which purpose the skulls were inserted. The female gopher pictured was 9½ in. long and from this the length of the other specimens can be easily computed. The two gophers were taken from specimens in the flesh; the mole was stuffed, as were also the two meadow mice. The shrew was an alcoholic specimen.

ADDENDA

The following notes were made up too late to be incorporated in the body of the text, and through the courtesy of the printer are here appended.

March, 28th, 1893—A pocket gopher just secured, containing four young embryos. See page 15.

From the cheek pouches [not to be confounded with the pockets of the pocket gopher] of a ground squirrel, captured at 10 a. m. on a day in last September, by Prof. F. E Loyd of Forest Grove, 21.1 grams or 50 c. c. of oats were taken, an indication of the amount of damage caused by these pests.

The galvanized iron tank figured in Plate II cost the department about $30.00. The wooden frame upon which it rests, and the cover cost, together, about $4.00.

In Fig. 2 Plate I. the light colored spot on each wing of the first codling moth figured is due to a break in the wing.

The details in the beetles [same figure] cannot be shown with the means our photographer has at his disposal.

Bulletin No. 12 from the Wyoming Experiment Station is just received,

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containing remedies for "Ground Squirrels." They advise the use of Bisulphide of Carbon manufactured and sold by E. R. Taylor, Cleveland, Ohio, for 10 cents per lb. on board cars at Cleveland. A gallon weighs about 10 pounds and is sufficient to treat 160 to 200 holes. The usual method is practised; saturate a piece of cotton the size of an egg with the fluid, throw it down the burrow and stop the opening with earth. *Never bring this inflammable agent near a light of any kind!!*



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Oregon Agricultural Experiment Station

Bulletin No. 26. May, 1893.

DRAINAGE.

Address Delivered before the Marion County Horticultural Society, Salem, Oregon.

BY

JOHN M. BLOSS,

President of State Agricultural College, and Director of Station.

The Bulletins of this Station are sent free of cost to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE.
H. R. CLARK, Manager,
CORVALLIS, OREGON:
1893.

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POTATOES.

H. T. French.

One hundred and fifty three varieties of potatoes were grown last season on the Experiment Station farm. Eighty-eight were grown in plats large enough to warrant a calculation of yield per acre. The remainder were grown in small amounts, to determine their manner of growth, as effected by our soil and climate.

The potatoes were grown on a clover sod which was plowed in the winter, and again in the spring just before planting. No fertilizer was used, except a dressing of wood ashes sowed on the field after planting.

The potatoes were cultivated with a Planet Junior, one horse cultivator, thus keeping the ground as level as possible. While the season was unfavorable for the potato crop, owing to the cold, dry weather, the yield was farely good, and the quality of the tubers was very good.

There was very little fungus growth, or dry rot, on the potatoes last season.

A thousand, one pound packages of potatoes were sent out to the farmers of the State last season for trial, and, in several cases, the results were unsatisfactory because of the fact, that fresh manure was plowed into the ground in spring just before planting. Manure applied in this way makes the best condition possible, for the development of fungus diseases. There is not moisture enough in the ground, to cause complete decomposition of the manure, and it serves as a most excellent culture medium for the germs of fungus diseases. Manure should be plowed under in the fall, so that it may become thoroughly incorporated with the soil, before the time of planting.

The mechanical effect of stable manures when applied in the spring, in making the soil too open and loose, is also detrimental to the growth of the potato plant.

Of the varieties, which seem to warrant recommendation after two years trial, we would mention the following.

Dublin Chief.—Smooth, white potato, with fine shallow eyes; round and slightly elongated in shape.

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soap in the proportions of 1 lb. to every 8 gals. of water. As this soap was used simply to secure an even spreading of the liquid and, possibly, to insure the permanency of the solution, I believe that ordinary soft soap would have answered the purpose equally well.

To this solution IXL was added, crushed in small pieces. 1 lb. of IXL to every 16 gals. of the liquid. This, as is well known, is a patent insecticide consisting of lime, sulphur and salt and sold by Wm. Beck & Co., 112 California St. S. F. and 26 North Front St. Portland. Or. Cost in Portland 4 cents per lb. in bbls. (500 lbs. to bbl.) 4½ cents per lb. in 60 lb box and 5 cents per lb. in bricks, any quantity. It was used the past season because previous experiments appeared to indicate that fewer sprayings were necessary when it was used, and on account of its fungicidal qualities.

The first application was made June 12th. but rain interrupted the work, and, more rain occuring a few days later, this first spraying was disregarded and a second application made June 17th., five daye later. On June 27th. the fruit was sprayed for the third time, in reality the second time, and the fourth or really the third spraying was made Aug. 18th. None of the Waxen or Summer Sweets were treated on this last date.

On August 5th the fruit on the sprayed trees appeared to be quite free from worms, even on a few which were not treated on June 27th and had. therefore, gone seven weeks since the last spraying. Two weeks later, however, Aug. 18th, the Baldwins and Rambos were found to be somewhat wormy, showing that they should have received a spraying three or four weeks earlier. This would have brought the third spraying three weeks after June 27th, *i. e.* about July 18th. *The need of thorough work at about this date is referred to later on.*

The apple-worm, owing largely to the very inclement spring, was not as bad this year as the preceeding season, and unsprayed orchards looked fairly well in comparison with those which had been sprayed. In October. and earlier, the leaves on some of the trees in the sprayed orchard were noticeably burned, more particularly on the Baldwin trees. The cause of this cannot, in this case, be ascribed to using too strong a mixture, but in the following facts which have been discovered by previous experiments. It has been observed that trees in counties adjacent to, or near, the coast, are more likely to be burned than those in the interior. Further, if a *light rain* occur during or immediately after the application, the leaves are apt to be burned. Such burning does not show, when paris green is used, for sometime after the application. A heavy dew, or hot sunlight, immediately after spraying are conducive to burning. Strangely enough, it has been found that the older leaves are more susceptible to injury than the younger leaves. The under side of the leaf also is more easily burned than the upper side. The very slight rain occuring during our first spraying, June 12. aided by other climatic conditions prevalent here undoubtedly caused the burning of the foliage. This injury was but slight, and, another season, might be absent altogether. It must be said, however, that the presence of soap in the mixture appears to make it more liable to burn, than when used without the soap, and for that reason it would be well to use a min-

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imum amount, just enough to cause the liquid to spread over fruit and leaf.

The effectiveness of wrapping burlap bands about the apple trees, as an adjunct to spraying, has been referred to before. Yet it must be borne in mind that the worm found beneath the band has accomplished its work, and spoiled the apple in which it was working. At the same time, many of the worms so killed, would, had they lived, produced female moths, which would have laid hundreds of eggs upon the fruit. In our experiments banding began in July, and the bands were examined every five days. In examining the bands, the greatest number of worms were found Aug. 25th, and Aug. 31st, 78 on the first date and 76 on the second,—from about forty-five trees. Inasmuch as it has been found that the larva lives four weeks in the apple before seeking a hiding place, it is evident that the mature worms found in such numbers from Aug. 25th—31st, were hatched about July 25th-31st,—*another argumeut to prove the necessity of a thorough application about July 20th*, in ordinary seasons.

I am convinced that three sprayings, with a fourth on later varieties, will, if judiciously applied, save a large percent of the fruit, and, as a result of the work of the past three years I unhesitatingly make to the farmer and fruit grower the following

RECOMMENDATIONS.

Spray with the solution above given for the first time about June 10th-15th, in ordinary seasons. A very early spring might call for an earlier application, yet it is very apparent that fruit growers, as a rule spray too early, there is no need for action until the apples are as large as marbles.

Let a second spraying follow the first in about three weeks, or a little earlier,—say July 1st—6th, and a third July 20th—25th. That should be sufficient on all early apples. A fourth is recommended for late apples Aug. 15th.—20th. These dates cannot be taken as criterions always, but they are based on careful observations here for three successive seasons.

As good a showing may be obtained, possibly, with some other agent in the place of IXL; we suggest it because with it we have had good results. Do not use too much of the solution, for it only makes burning more probable.

It might be well to decrease the amount of soap used, to about 1 lb. in every 15 gallons, just enough to cause the liquid to spread evenly over leaf and fruit. Begin banding about July 4th.

COST.

The large trees used in the above experiments were 30—40 years old and each tree required from 2 to 3 gals. of the mixture. This called for an expenditure of 7 cents per tree for each application, for labor and material. Smaller trees, requiring less, would not call for that sum.

It is an interesting fact, though having no especial bearing on our work here, that in Nebraska, in 1892, the Codling Moth caused a loss of $2,000,000, a very large proportion of which might have been saved by judicious spraying.

PROPOSED WORK

The Botanist and Entomologist are planning a series of experiments for the coming season to determine the practibility, as far as Oregon is

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concerned, of combining fungicides with the arsenites, that the scab and other fungus diseases together with insects which prey upon apple, pear &c. may be killed with the same application. This operation saves the cost of a special treatment for either vegetable or animal pest, and is much to be desired.

HOP LOUSE.

This pest was not as bad this season as the year preceding, owing to the cold rainy spring, unfavorable to any insect life. The statement having been made, by a few hop growers, that kerosene emulsion, 1 part to 30 parts of water, injured the foliage of the hop plants, the Entomologist applied it considerably stronger, 1 part emulsion to 20 parts water, on hops planted on the College grounds. Even at this strength no injurious results were observed, and it must be concluded that the fault, in the cases referred to, lay in its manufacture or application, or both. Kerosene however in the hands of the uninitiated, is a dangerous agent, and our hop growers feel more confidence in the quassia soap remedy, or tobacco and soap. which compounds have frequently been quoted in publications emanating from the U. S. Department of Agricultnre, in bulletins published by this department of the experiment station, and elsewhere.

If opportunity offers, experiments will be instituted the coming season with a weak solution of Koebele's Resin Wash.* This wash promises to be a valuable agent against all forms of plant lice. It has in fact, already proved itself an efficacious agent. Its special value lies in the fact, that in a weak form it may prove fatal to the tender-bodied lice, and at the same time not kill the predaceous insects which feed upon them, and are found amongst them in considerable numbers.

The experiments proposed for next season are to determine how weak a solution will kill the hop lice and not injure the beneficial insects which occur on the hop.

It is propable that our hop growers will always have this pest to combat, and during some seasons, its ravages will be felt very severely if radical efforts are not made against it.

FLEA BEETLES AND RADISH FLIES.

Briefly, this experiment consisted in testing on turnips and radishes the comparative value of tobacco water (1 lb. of waste stems steeped in 2½ gals. water) air-slaked lime, and ashes as a preventive of the attacks of *Phyllotreta decipiens* and species of *Anthomyia*. The small "worms" found in minute brownish burrows near the top of radish and turnip roots are the larvae of the above flies. The result was a corroboration of previous work in this direction, viz. while lime and ashes are good, more frequent application are called for than when tobacco water is used. About three applications of tobacco water liberally applied with a watering pot, at intervals of two weeks, beginning when the plants are about a week old, will be found efficacious. As stated in a previous bulletin, this liquid is not only repulsive to the insect, but, sinking about the roots acts as an excellent fertilizer. Especially is this noticeable in the case of radishes.

The lime was applied to the plants with a Leggetts' London Purple

* RECEIPT FOR RESIN WASH: To 3 lbs of carbonate of soda (common washing soda,) add 4 lbs of resin and 1 gal. of water. Heat until dissolved, and while boiling gradually add 4 gal. of hot or warm water, stirring all the time, and continue the boiling until the mixture is the color of molasses. When wanted for use, warm and dilute as follows with cold water: For Woolly Aphis 1 part wash to 6 parts water; for any other aphis 1 part wash to 10 or 12 of water; for Mealy Bug, 1 part wash to 10 parts water.

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Gun (Leggett & Brother, 301 Pearl St. New York City) which is shown in a line cut below. By means of a strap which accompanies this machine and which passes over the shoulder of the manipulator, the gun can be held at the level of the waist, with the muzzle end just above the plants, and any dry insecticide easily applied.

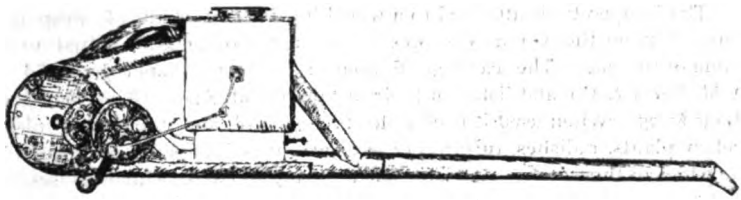


FIG 1.—Leggett's London Purple Gun.

Through courtesy of G. C. Davis of the Michigan Agricultural College we are privileged to insert here a cut from an original drawing of a machine of his invention, proposed, primarily to kill leaf hoppers, but also well adapted to catching and killing flea beetles on very young plants.

The machine is called a "hopperette".

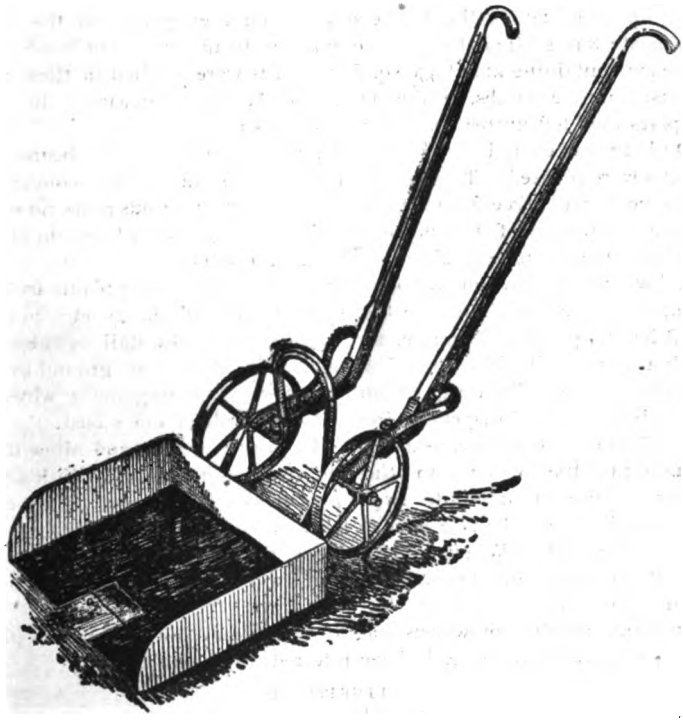


FIG. 2.— A Hopperette.

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Quoting from his description: "A small tarred pan is attached to a hand wheel hoe as shown in figure. The pan is made of sheet iron. The bottom is 16 in. by 20 in. with a notch 6 in. deep by 4 wide cut in the centre of the front edge. On two sides and back is an upright sheet about 4 in. high. The edges of front edge and notch are rolled up about ⅛in. simply enough to keep the coal tar on bottom from rolling off.

The hopperette is attached to a wheel hoe by two strips of strap iron fastened under the pan as a support and at the other end bolted to the frame of the hoe. The carriage figured in cut is a "Planet Jr". sold by D. M. Ferry & Co. and listed in their catalogue at $4.00. The pan costs about $1 25. When used it is close to the ground and the young plants (celery plants, radishes, turnips etc.) are surrounded on sides and back by the edges of the notch. At *a* is a small string or wire which causes the insect to jump at the right time, and also prevents the plants from striking the sharp edge of the iron. As the machine is wheeled along and the plants disturbed as indicated, a large proportion of the insects will jump on to the tar and perish".

WIRE WORMS AND CUT WORMS.

Three plats each containing about 900 sq. ft. were treated May 10th. with Kainit & Muriate of potash, in the proportion of Kainit, 1000 lbs. to acre on one plat and 600 lbs. to the acre on another plat. On the third plat Muriate was applied at the rate of 600 lbs. to an acre. On two other plats, each containing about 450 sq. ft. the salts were applied in these proportions: Kainit 2000 lbs. to the acre, and Muriate the same. In each case, plats were left untreated to serve as checks.

On both treated and untreated plats, corn, tomatoes, peas, beans, and cabbages were planted. This season, as far as this valley was concerned, being exceptionally free from these sometimes very injurious pests, no result was obtained worthy of note beyond the increased growth of certain of the vegetables, due to the fertilizing qualities of the salts.

A few excellent preventives of cut-worm injury to garden plants are here appended. (*a*) When planting cabbage plants, tomato plants, etc., hold in the left hand a paper 3 in. square, and wrap it around the stalk of the plant in such a way that it will extend from about 2 in. above the ground to one below the surface. These papers can be easily cut, strung on a wire and carried about the field suspended from a button hole of one's coat.

(*b*) Throw old tomato cans and the like into a bonfire and allow them to remain until the two ends and the side become unsoldered. With a pair of shears cut the tin tube into two equal pieces lengthwise. Wrap each piece around a broom handle so as to form two tubes about 6 inches long and 2½ inches wide. When wanted for use, the tube can be sprung open to admit the stalk of the plant, and it should then be pressed into the ground about ½ inch.

(*c*) Hand picking of worms and digging them out from near a plant which they have cut has already been referred to.

TENT CATERPILLARS.

These pests have been so prevalent the past season, that remedies and

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preventive measures, which were given in Bulletin No. 14 are here repeated. The hairy larvæ, so prettily marked, are by this time very well known to our citizens. They turn into moths much like the one figured on the title page of this bulletin.

Where fruit trees are sprayed with the arsenical solutions for the codling moth the foliage is necessarily poisoned, and the above caterpillars being leaf eaters, are killed by eating the leaves. A very excellent, and very necessary preventive is to destroy the egg clusters on the leafless trees in autumn, winter, and early spring when they can be easily seen, by cutting off and burning infested twigs. The eggs are clustered in a dark band around the twig. Another remedy is equally simple; saturate a rag with kerosene, attach it to a pole, light it and burn the webs when the caterpillars are within. Crushing the very young caterpillars with the gloved hand, when they are massed together, is also recommended. Several parasites attack this larva, so man is not alone in his efforts to destroy them. A few of our birds, but not many, feed upon these pests. The eggs of *Clisiocampa* found in August will not hatch until the following spring.

GOPHERS AND MOLES.

The station has obtained a sample of the breech-loading Breese Riggs Animal Gun, invented, manufactured and sold ($3.00) by Miss Emma Riggs of Crowley Or. The principle involved in its use is the same as in the muzzle-loading Dikinson Gun figured in Bulletin No. 25.

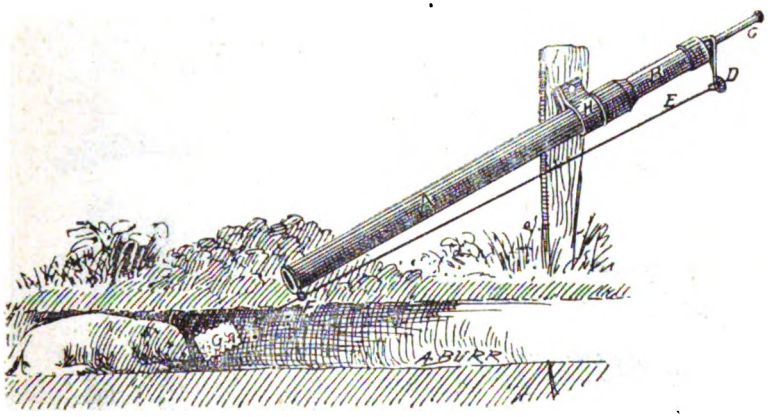


FIG. 3.—The Breese Riggs Animal Gun.

The hard wood stake to which it is attached is driven into the ground and the barrel can be pointed down the burrow at any angle. It calls for a 16 gauge shell, a very light charge of powder (about 1½ thimbles full) and about 30 pellets of No. 6 shot. We regard it as a very efficacious machine, and the fact that it is a breech loader makes it an easy gun to load or unload.

Moles can be shot with an ordinary shotgun, if one is so fortunate as to have such a weapon when he observes the earth of the mound moving. Such movements indicate that the mole is just below, and a good marksman can kill the animal when standing 25 or 30 feet away. Spearing them

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when so engaged has been referred to in a previous bul'etin. The so-called "Mole plant" (*Euphorbia lathyris*) is thought by some to prevent depredations, of moles at least, when planted in gardens. This idea however meets with but little encouragement from close observers.

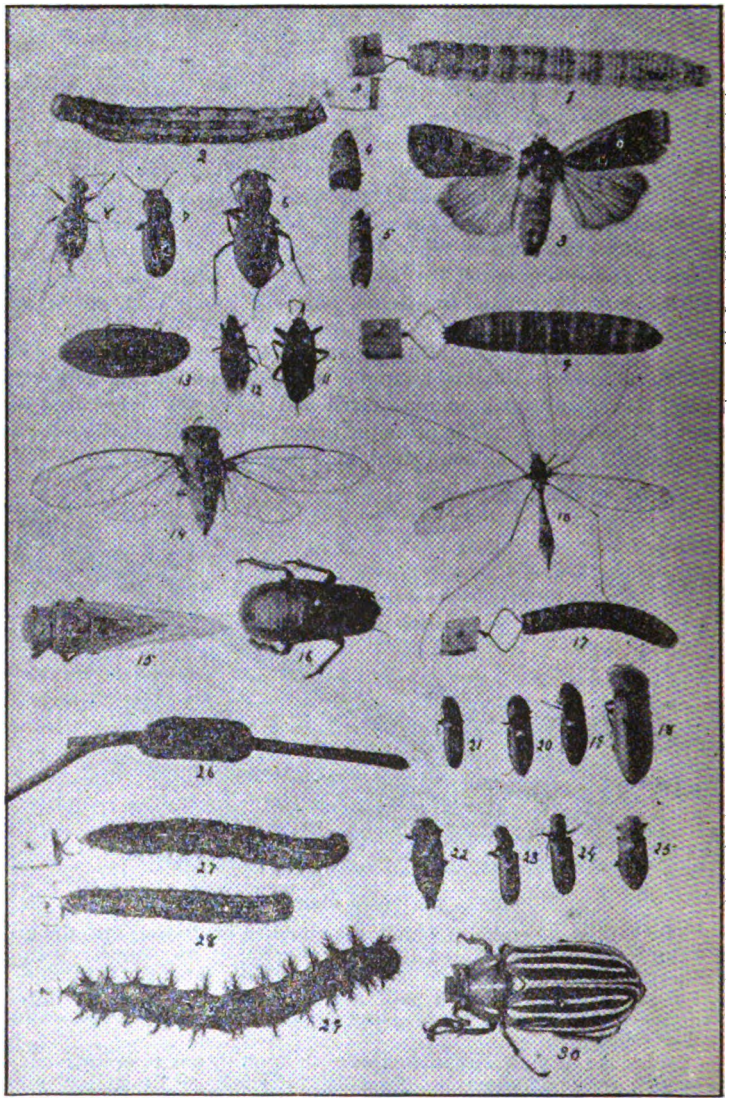


PLATE I.

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EXPLANATION OF PLATE I.

Figs. 1 & 2, Cut worms, *Hadena devastatrix* and *Leucania* (Sp?) respectively. Fig. 3, Moth (*Rhynchagrotis confusa*) from cut worm. Figs. 4 & 5, Codling Moths. Fig. 6, *Omus californicus* a predaceous beetle and hence a beneficial insect. Fig. 7, Another predaceous beetle (*Pterostichus californicus*). Fig. 8, *Cicindella 12-guttata*, a Tiger Beetle, predaceous in habits and commonly regarded as a useful insect. Fig. 9. Larva of Crane Fly. Found in decaying vegetation. Fig. 10. Perfect insect or imago of Crane Fly. Fig. 11. *Largus succinctus*. Fig. 12. *Leptocaris trivittatus*. This and the preceeding belong to the order known as Hemiptera or bugs. They are abundant, frequently seen about maple trees, and also feed on the juice of bruised cherries, berries etc. Fig. 13 A beetle which bores in fir (*Buprestis aurulenta*) quite common in Oregon. Fig. 14, *Cicada areolata* (allied to 17-year Locust) with wings, expanded. Fig. 15, Same with wings closed, Fig. 16, Pupa of a Cicada. Fig. 17, A wire-worm; injures wheat, tomato plants, potatoes, beans, etc. Fig. 18, Click or Snapping Beetle which comes from the wire-worm. Fig. 19 and 20, Two Click beetles (*Corymbites fabrax*). Fig. 21, Another Click beetle (C. *cylindriformis*). Fig. 22, *Dicerca divericata*, a beetle frequently seen on peach, cherry, or prune trees. Its larva bores in the wood of these trees just below the bark and resembles the larva of the Flat-headed Apple-tree Borer (*Chrysobothris femorata*) Fig. 23 and 24 Branch and twig borer, (*Polycaon confertus*,) Fig. 25, The beetle which comes from the Flat-headed apple-tree Borer, (*Chrysobothris femorata*). Fig. 26 Eggs of "Tent Caterpillar" Fig. 27 and 28 "Tent Caterpillars" larva of *Clisiocampa* (*C. pluvialis* and *C. erosa*, respectively) Fig. 29. Larva of *Pseudohazis eglanterina* which feeds on Wild Rose. Fig. 30. "Ten-lined leaf eater" *Polyphylla decemlineata*.) Its larva feeds on roots of grass.

All figures in Plate I but slightly reduced from natural size.

PLATE II.—SOME SAMPLES OF INSECT WORK.

I. Woolly Aphis (*S. lanigera*) on apple.

II. San Jose Scale (*Aspidiotus perniciosus*.)

III. Oyster-shell Scale (*Mytilaspis pomorum*.)

IV. Work of Scolytid Borers on young Baldwin. Piece of bark removed to show burrows.

V. Work of Blackberry and Raspberry Cane Borer.

VI. *Corythuca* on under side of Apple leaf. This insect has been reported to the station at various times but is not numerous enough or injurious enough to be regarded as a pest.

VII. Work of Pear and Cherry-tree Slug.

VIII. Currant stem hollowed by the Currant Borer.

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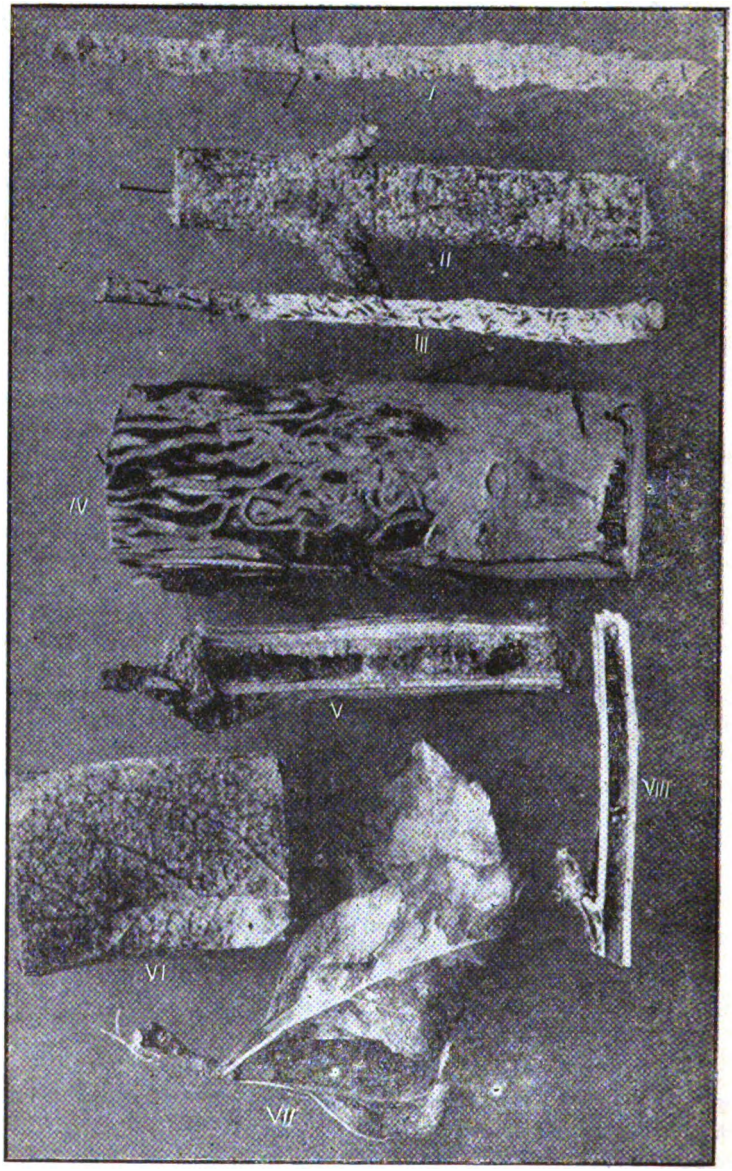


PLATE II.

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CAPONS AND CAPONIZING.

F. L. Washburn..

WHAT IS A CAPON?

A capon bears the same relation to a cockerel that a steer does to a bull; it is an altered rooster. As in the case of steers, a capon is more quiet, lays on much flesh and fat and remains tender for many months after the operation. Caponized birds 17 and 19 months old have been killed here whose meat was extremely delicate snd tender. They will, furthermore, weigh from 20 to 30 per cent more than a rooster of the same age if kept the proper length of time, and, in many Eastern markets will bring from 18 to 30 cents per pound. The comb and wattles do not grow after the operation. The feathers of neck and saddle grow enormously long and become very glossy. They do not chase the hens; they neither crow nor fight. For a few months after caponizing they are very hearty eaters, but later do not consume appreciably more food than ordinary fowls. If the operation does not succeed in removing all of the testicular matter or the sac (*tunica vaginalis*) inclosing it, the glands grow,—sometimes to an enormous size, and assume distorted shapes. The bird is then what is known as

A SLIP.

A slip gains flesh and fat and better flesh than a cockerel,—grows rapidly, and for a time resembles, as far as outward appearances go, a genuine capon. But after a while,—three or four months after the operation, the comb and wattles grow, the bird developes a crow, and chases the hens worse than a cockerel. It is evident that its period of gain has at this point ceased and it should be killed without delay. The meat of a slip is superior, as said above, to that of a cockerel and in some markets sells for nearly as much per pound as that of a capon.

IS THE OPERATION CRUEL?

No more so, and not so much, as the same operation performed on pigs, colts and calves. It is quickly done, and the bird begins to eat directly after being released from the caponizing board. Not over 2 per cent of birds need be lost by even an indifferent operater, and any chick so killed dies from hemorrhage and is as good for table use as though death had been caused by beheading. The beginner should practise on two or three dead cockere's first, in order to become familliar with appearance and position of organs before attempting to handle a live bird.

INSTRUMENTS NEEDED.

Caponizing instruments are sold in sets by Geo. Q. Dow, North Epping N. H., by W. H. Wigmore and Co. 107 So. 8th St. Phila.. the latter firm represented on this coast by the Petaluma Incubator company, Petaluma, Calif..—by Geo P. Pilling & Son 116 South 11th St., Phila., and others. Single instruments can be purchased from most of these firms, as shown in their catalogues. These tools sell, in sets, for from $2.00 to $5.00 and over. The instruments actually necessary are a sharp penknife or scalpel, a spring or spreader. Fig. 4 (A & B) to keep the ribs apart, a caponizing canula Fig. 4 *C.* in some form, a delicate steel hook Fig. 4 *D*, and a pair of fine long

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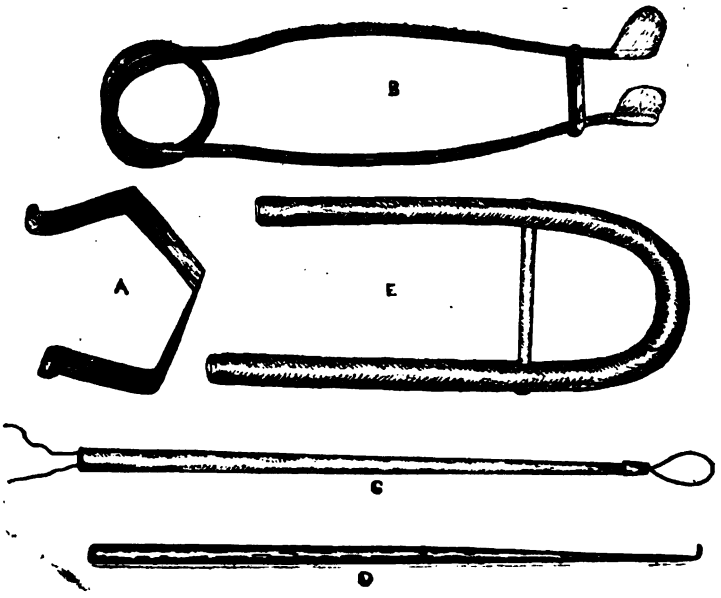


FIG. 4.—(All figures in this group are about ½ actual size.)

forceps. To these might be added a pair of small sharp pointed scissors. One should have also an oval caponizing board (Fig 5.)

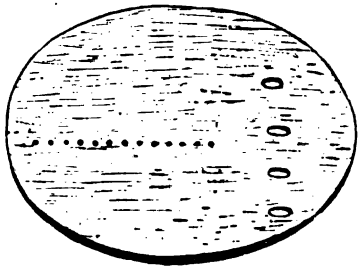


FIG. 5.

The board we used is 2 ft. by 1½ in its two diameters. Eight inches from one side is a row of thirteen holes ¼ in. in diameter and one and one half inches from each other. At one end are four oval holes about 1½ in. long aud ⅝ in. wide, (see Fig. 5.) The small round holes are to hold the ends of the staple, Fig. 4 *E*, which passes over the wings of the fowl. Through the oval holes a double strap is carried over the *scaly part* of the legs and, by means of a weight at the end beneath the board, holds them firmly. The iron staple, which is used as above indicated, is four inches long, with a cross bar 1½ inches from the rounded end. The staple must fit snugly in the round holes. The distance between any two of the round holes is just one half the distance between the free ends of the staple. The hook, Fig. 4 *D*, can be made from a dentist's pick or from a crochet needle, and is used to tear the delicate membranes found in the body cavity of the fowl, and concealing the viscera. A spreader Fig. 4 *A* can be made with a well tempered piece of steel. It

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is 2½ in. wide and each arm is 1½ in. long. Allowing for the turning up of the ends, the peice of steel from which this spreader was made was about 6½ in. long, and ⅜ of an inch wide. Such a spreader should be very pliable. The spreader represented at *B* Fig. 4, which can be purchased for a small sum is to be preferred for young birds, and the stronger spring should be used only when the ribs do not yield easily; at which time, by the way, the bird should not be caponized. A caponizing canula can be purchased. The one used here, however, Fig. 4 *C* was made from a blow-pipe which had its smaller end flattened and just enough of a slit left at this end to allow of the passage of the wire loop. We prefer fine silvered wire (Malin & Co No. 32) to the horse hair used by many. The spreader shown above, Fig. 4 *B*, is somewhat too long and we would reccommend the shorter improved style shown in Fig. 6.

THE OPERATION.

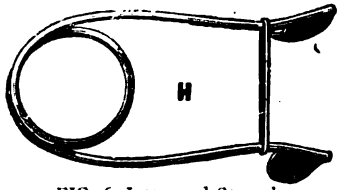


FIG. 6. Improved Spreader.

The bird, which should be between 2½ and 4 months old, has been kept without food or water for 24-30 hours in order that the intestines may be perfectly empty. It is placed on the caponizing board, its wings pinioned with staple (do not press wings too closely together) and its legs fastened firmly by the weighted strap referred to above. The board has been placed on a barrel, say, or something of the proper height, and preferably out of doors, where plenty of light, direct sunlight if possible, is obtainable. It is well to wet the feathers on side, in front of thigh, that they may the better be kept out of the way. Brush them back to bare the

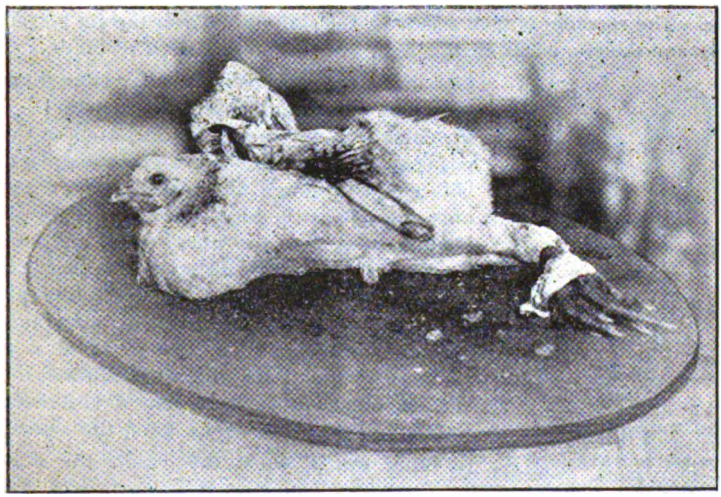


FIG. 7.

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skin. With a scalpel or sharp pen-knife cut through the skin at right angles to back-bone, and half way between shoulder and thigh. Let this cut be about 1 in. long or more. Then push the skin back and cut through the muscles *between the last two ribs.* Insert spreader to keep ribs apart. Your bird will then have something of the appearance shown in Fig. 7. Allow no foreign matter, feathers etc,, to fall into the cavity while operating. With hook tear away the delicate tissue which you see hiding the intestines. This tissue is the wall of an abdominal air-sac. The intestines exposed, push them to one side and note the testicle of the side upon which you are working, lying close to the back and about on a level with the front edge of the thigh. It is an oval body, generally whitish, but not constant either in size or coloration. If the chick is very young it may not be much larger than a grain of wheat, but in the larger breeds of fowls, at four months of age, it will be considerably larger, and in quick growing fowls, like the Leghorns[and, by the way, it does not pay to caponize these] the glands at four months, may be nearly as large as a sparrow's egg. Note the blood vessels close to the testicle, and sometimes directly in contact with it, running along the back in the middle line; the pulse in the artery [*dorsal aorta*] is distinctly visible. Insert caponizing canula and place wire loop over testicle. Extreme care must be taken *not to include either of the large bloodvessels in the loop.* If you tear either of these your bird will bleed to death. At the same time the entire gland must be included; *failure in this particular means a slip.* Now keep the end of the canula closely applied to the gland and draw upon the wires firmly. The result is that the wire cuts the testicle free from the tissue supporting it and it can be picked out of the abdominal cavity with the long handled forceps. With forceps also, or with spoon, remove all foreign particles which may have got into the abdominal cavity such as peices of feathers, clotted blood etc. The spreader is then removed, the skin drawn over the cut beteen the ribs and the two edges of the skin stitched together. This takes a little more time, but we believe it is far more humane than just twisting the feathers together. Turn the chick over and repeat the operation on the opposite side. Many professional caponizers remove both glands through the same cavity, *i. e.* open only one side of the bird, but it is hardly advisable unless one has the finest set of instruments, the Chinese tools for instance, and has become very expert in their use. The bird is then placed in a dry coop, and given plenty of water and soft food frequently (but not two much at a time for three or four days and then allowed to run with the other fowls. Sometimes a bird becomes "wind-puffed" a few weeks after the operation. In other words, when the cut in the skin has healed, air gets between the skin and the muscles, from the broken air sac. This can be easily remedied by puncturing the distended skin with a coarse

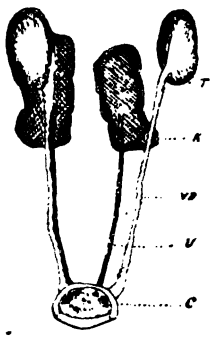


FIG. 8, Urogenital organs of male fowl: T. *testicle*, V. D. *vas deferens*, K. *kidney*. U. *ureter*, C. *cloaca*. (reduced.)

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needle and forcing the air out. Or, if left alone, it will eventually remedy itself.

BEST BREEDS, AGE, ETC.

In our estimation the Light Brahmas or the Plymouth Rocks make by far the best capons. The black Langshans are excellent also, albeit they are very slow growers. Partridge Cochins are highly spoken of. The Indian Games make fine capons, as well as crossses of this species on other large breeds. A turkey was caponized here the last season, but results are not definite enough to warrant a report yet.

As to age, many caponize as soon as they can distinguish the sex of the chick. The important point is not to wait until the glands are large and the ribs become stiff, and unyielding.

EXPERIMENTS AT CORVALLIS,

These experiments were not intended to give results in minute detail. That will come later perhaps, when a flock of capons can be kept at the Experiment Station. The conditions under which the work was done here has been purposely made the same as would be found on any farm. The capons were given no special care nor special food, and the results show conclusively a gain over birds untreated. About thirty fowls were used in the experiments. Two or three of the first caponized were accidentally killed. A few proved slips. Untreated roosters of the same species and same brood were used as checks in many cases, but, owing to the fact that all the birds belonged to the writer's flock, it was impracticable to keep checks for each bird caponized, hence the apparent meagerness of the report in this direction. The following table gives the data as regards comparative gain of a few of the subjects, enough being quoted to give a fair idea of the experiment.

No.	Breed.	Date of Caponizing.	Age and weight at operation.	Date of 2d weighing & amount of weight.	3d weight.	4th weight.	Date of killing and age at death.	Live weight at death.	Weight dre sed.
13	Cross; Plymouth Rock & Brown Leghorn.	Nov. 20 1891	5 months 2lbs 15½ oz.	Feb. 3 1892 4¼ lbs.	Mar. 12 1892 5lbs		Aprl. 9 1892 10m 21d	5lbs	3½lbs
14	Same; check on No. 13.		2lbs 8½ oz.	4lbs.	4lbs		"	4lbs	2½lbs
12	Black Langshan.	Nov 20 1891	5 months 2lbs 11 oz.	Feb. 3 1892 6lbs.	Mar. 12 1892 7¼ lbs	Aprl. 30 7¾ lbs	Dec. 9 1892 17m 19d	10½lb	7¾lbs
25	Light Brahma.	Dec. 11 1892	5 months 3lbs 6 oz.	Feb. 1 1893 6½ lbs	Sept. 12 1893 8lbs	Feb. 12 1894 8⅛ lbs	Feb. 12 1894 19ms.	8⅛lb	6½lbs

No. 12, In excellent condition, No. 25, In good condition. see Plate III.

No 12 shows an average gain per month, after the operation, of 9.9 oz. The check on No. 12 was not kept as long as the capon, for lack of facilities, but during eight months time, it showed an average gain of 6 oz. per month. Number 25 should have been killed in Sept. 1893 for, as shown in table, there was hardly any appreciable gain after that time. The bird is figured alive and dead in Plate III at the end of this bulletin.

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HOW TO PREPARE A CAPON FOR MARKET.

Keep the bird twelve hours without food, that its crop may be entirely empty. Then suspend by the feet in a convenient place. Have ready a two or three pound weight attached to a hook. This is to fasten to the lower mandible or "lower jaw" of the bird after he is dead to keep him steady and facilitate picking. Seize the head of the fowl, open his mouth and cut the veins and arteries [jugulars and carotids] at the back part of the throat by running a sharp-pointed knife into the back of the mouth. a French Poultry Killing Knife is made expressly for this purpose. As soon as blood vessels are cut, run the knife through the roof of the mouth into the brain. Then pluck the bird immediately, without scalding. This method is most approved of by experts, as the bird is not in any way disfigured. One may cut both of these bloodvessels from the outside by running a sharp pen-knife into one side, a little back of and below the ear, thus making only one wound. This one wound however might be objected to by the marketman. *Never chop off the head!* In plucking, the feathers of the two outer joints of the wing, the feathers of the upper part of the neck, the tail feathers, together with the long feathers of the saddle, and a few feathers on the lower end of the drumstick should be left [See Plate III]. Do not cut off the feet. If the head is bloody, wash off the blood. As regards dressing; cut carefully around the vent and pull out the intestines, scraping off the fat with which they are covered and leaving it (the fat) in the body cavity, when the end of the intestines is reached, break them off just below the gizzard. Leave gizzard and every-thing else, except the intestines, in the bird. Turn the mass of fat, around the opening you have made, outward, and let it harden, it will improve the appearance.

Capons should be packed, when thoroughly cooled, in new boxes lined with white paper. They should be packed solid, backs up, care being taken not to bruise them. This is the approved way of preparing a capon for the market. Buyers of capons at once recognize it as the bird calling for 30 per cent more per pound than an ordinary fowl. For our own use, however, we should never take such pains; it is recommended because such a method obtains fancy prices.

THE BEST AGE FOR KILLING.

On this point opinions seem to differ. One authority says: "Capons should be kept until two years old; another, Mr. Cushman of the Rhode Island Experiment Station, says "Capons killed at eleven months of age are preferred, as they get coarse and "soggy" if kept until twelve months or longer". In spite of this last assertion we have found at least two capons, Nos. 12 and 25 to be in good condition at 17 and 19 months, and they certainly gain after twelve months. As far as our experience goes we would recommend keeping them at least thirteen or fourteen months from date of hatching.

WILL IT PAY IN OREGON.

Unless fowls are sold by the pound it ceriainly will not pay from a financial standpoint. In Portland, we understand, and in a few of our other

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large cities, the practice of selling poultry "by the dozen" is gradually disappearing. When fowls are sold by the pound, as they should be, it will be an easy matter for the raiser of capons to successfully compete with those furnishing the scrawny tough fowls now displayed in our markets.

Quoting from a list of prices in Boston Market for 1891 and 1892 we find that from Jan. 1st to May 15th. New Jersey Capons sold for from 20 to 28 cents per pound. At the same time broilers were bringing from 15 to 55 cents per pound. When capons are scarce, which happens in early summer, they bring much more per pound. On July 7th 1892 capons weighing nine and ten pounds were retailing in Fulton Market, New York City, for 35 cents per pound. The latter part of May 1891.—a member or the firm of Edson Bros. and Gilman wrote to Mr. Cushman of the Rhode Island Experiment Station, that he could that day sell a ton of capons, if he had them, at from 26 to 28 cents per pound.

It is probable, that if our wealthy people could be educated to the point of appreciating capon meat and they would doubtless prove apt pupils, this favorite of epicureans would command good prices in Portland and elsewhere throughout Oregon. A market man in our metropolis told me a short time since that he had no doubt but that fancy prices could be realized on capons, and expressed a willingness to contract for a large number for February. He did not, however, state what he wou'd pay for them.

The use of the incubator, in order to bring capons on the market all through the year, and in large numbers, is, very evidently, a necessary adjunct to the business as well as an absolute necessity in the production of early broilers on a large scale.

NOTES

No antiseptic precautions were taken in our experiments.

A physicians head mirror strapped to the forehead will enable one to perform the operation by lamplight. Such a mirror can be purchased for from $5 to $6 of Geo. Tieman & Co. New York City.

Are slips fertile? Can they be used for breeding purposes? This question we attempted to solve a year ago, by placing a slip with a hen just beginning to lay while cooped with her chicks She had been separated from the rest of the flock for about five weeks. For a week after the introduction of the slip into her yard, each egg laid was tested in an incubator and none were fertile.

Another experiment along the same line gave practically the same results, and, though, the experiment *must not be regarded as by any means conclusive* it would seem, that, owing to mechanical injuries incurred in the operation, slips as a rule cannot be used for breeding purposes. It is easy, however, to imagine exceptions.

In the course of this latter experiment, an interesting fact, though not a new one to many, was brought out. It was necessary that the hen used in the experiment should be laying sterile eggs, and to insure this the eggs of the isolated hen were tested daily in an incubator. *Each egg so tested proved fertile until the 17th day after isolation*, at which time the slip was placed in the pen.

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Professionals have written to us stating that, when a fowl believed to be a capon is observed treading a hen, such fowl must necessarly be a slip. This is directly opposed to our observations. Capons were occasionally seen to bristle up to a hen and at other times to tread. Such fowls when killed were dissected and carefully examined, but not a trace of testicular tissue was found, and both *vasa deferentia* (the "cords") were rudimentary, that is, had not grown to any extent since the operation. It would seem that the genuine capon is as likely to show this instinct, as a steer in a drove, or cows at pasture.

Quoting from a very excellant bulletin on the subject of caponizing from the Rhode Island Station; "Large birds sell the best; the heavier the better. When ten pound birds bring 22 cents, 25 cents will be given for twelve pounders and 28 cents for those weighing fourteen pounds.

Some workers in this line claim to be able to caponize a bird in five minutes or less, but such do not sew up the wound.

Do not use fingers in removing glands or any spoon forceps recommended for twisting off the testicles. We have found caponizing canulas which allow of the wire being pulled through them, thus cutting off the esticle, superior to anything else and we would heartily recommend them. Others may have had a different experience.

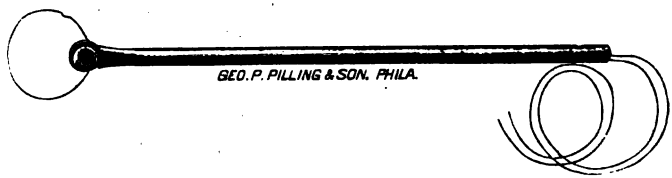


Fig. 9. The Pilling Canula, made by Geo. P. Pilling and Sons. Philadelphia.

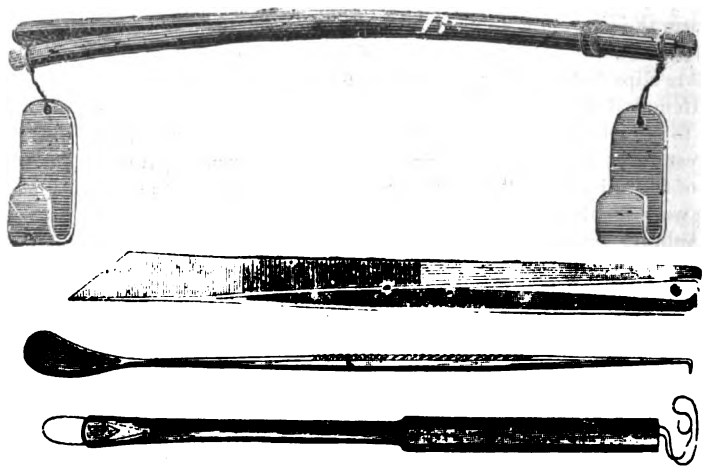


FIG. 10.— A whale bone spreader in the Chinese set of tools; a combined knife and forceps and a combined spoon hook, also in this set. The last illustration is a canula made by Wigmore and Co.

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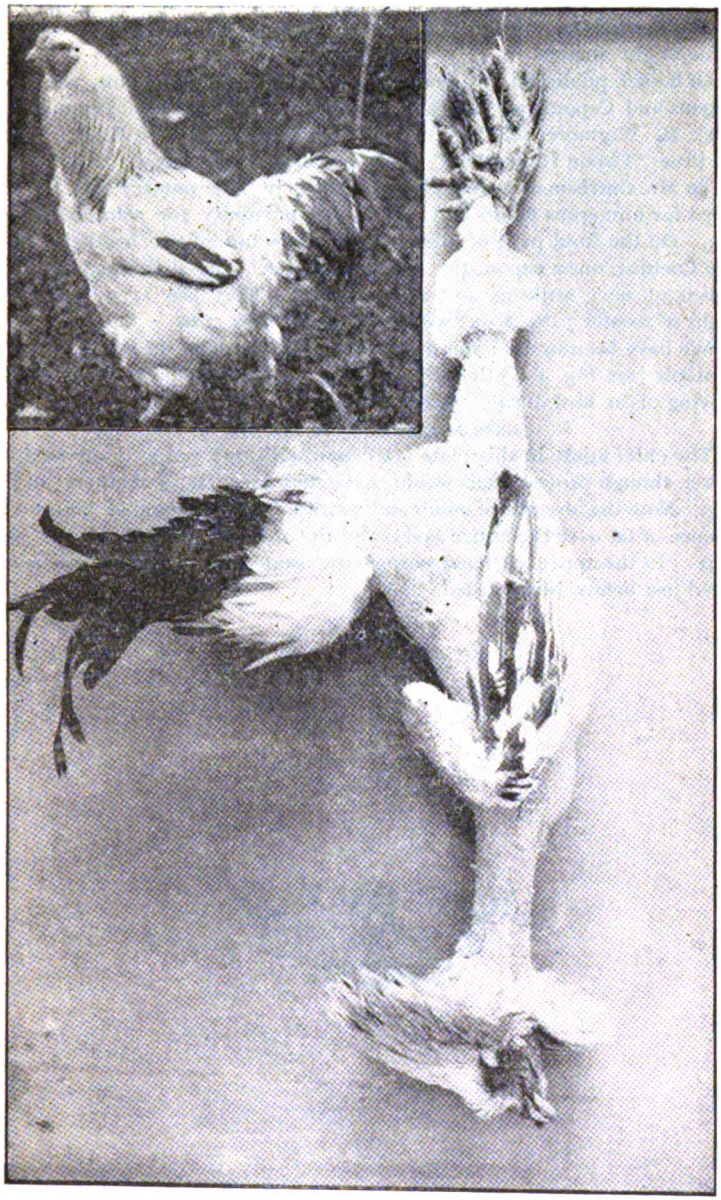


PLATE III.

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As mentioned before we found fine silvered wire, Malin No. 32. preferable to horse-hair, yet much of our caponizing has been done on birds a little old for the operation. For very young birds a horse-hair, single or double might answer.

Of books published by dealers in caponizing instruments we have "Capons and Caponizing" by G. Q. Dow 1890 (25c) "Practical Caponizing" by W. H. Wigmore 1887 (25c) "Guide for Caponizing" by G. P. Pilling 1892 (free) "Capon Hand-book" by Greely Bros. 1892 (10c).

To Mr. Garrison of Forest Grove, dealer in fine poultry we are indebted for numerous favors and take this opportunity for acknowledging same. On the front page of this bulletin is a picture of two brothers' Partridge Cochins, one a capon, the other a rooster. The difference in their heads is at once striking and characteristic. They are 11 months old, weight of rooster 7 lbs. 2 oz.; weight of capon 8 lbs. 2 oz.

We have been in the habit of wrapping a rag around the cross peice of the staple [see Fig. 4 *E*] thereby forming a cushion which rests against the wing of the bird during the operation.

EXPLANATION OF PLATE III.

The chief figure in this plate is a capon [No. 25] properly dressed for market, though professionals would have left more long feathers on the wing. Note the absence of comb and wattles, the full rounded breast, the presence of fat over the entire body, and the absence of sharp angles any where. In the upper left hand corner the same bird is shown as he appeared just before being killed.

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OREGON AGRICULTURAL EXPERIMENT STATION.

Bulletin No. 32. November, 1894.

BOTANICAL DEPARTMENT.



Five Farmers' Foes.

Canada Thistle. **Bull Thistle.**
Sow Thistle **Chinese Thistle.**
Russian Thistle.

MOSES CRAIG, Botanist.

The Bulletins of this Station are sent free to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE.
H. R. CLARK, Manager,
CORVALLIS, OREGON:
1894.

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Tent Caterpillars.

F. L. WASHBURN.

Three forms of tent caterpillars have been abundant in the Willammette Valley during the past season, *Clisiocampa erosa*, *Clisiocampa plurialis*, and *Clisiocamba constricta*. The first named feeds upon almost everything but the pear, viz upon apple, quince, cherry, prune, rose and privet. The second has not been nearly as numerous as *C. erosa*, about one of *pluvialis* to every one hundred of *erosa* representng their proportionate abundance. *C. constricta* devastated whole groves of oak, particularly *Quercus Garryana*, and though they occasionally migrated to the prune tree, thereby cansing considerable alarm among orchardists, they have nowhere injured fruit trees. Experiments with this oak tree form in the entomological laboratory, demostrate the fact that they will not eat the leaves of apple, plum, or prune.

These three forms are figured on the front page of this bulletin with the appropriate label attached to each.

DESCRIPTION, LIFE HISTORY, ETC.

The life history of the group known as "Tent Caterpillars" has been described in a previous bulletin. These larvae transform into brownish or cream colored moths, about one inch long, the females of which lay their eggs in a band around twigs on their several food plants. These eggs, in case of the first two forms, are covered with a slate colored gelatinous cement, which hardens as soon as deposited, and constitues the first food of the newly hatched larva. The egg bands of *C. constricta*, however, are whitish.

The moths are on the wing during July and August and deposit a new batch of eggs. These eggs however, do not hatch until the following season, as has been determined by observations here, and therefore we need only look for one brood, though irregularity in time of hatching of the eggs cause the visitation to extend throughout the summer.

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I append a popular description of each form, which will doubtless, be intelligible to all.

C. errosa. Whitish, irregularly oval spots on middle of back on all but the first few segments. On either side of these spots, and somewhat separated from them is a broad blue band bordered on either side by a brick red line. Below that, on either side, and reaching to the legs is a bluish space, characterized by one blackish dot on each segment marking the position of spiracles or "breathing holes". Below, the caterpiller is dark blue with oval black spots in median line on all but first few segments. Over the whole caterpillar are numerous fine yellowish or cream colored hairs.

C. pluvalis. The oval whitish dots of *C. erosa* replaced by linear blue spots on all but first few and last three segments, each bordered by black, and outside of that a mass of yellow broken into by black spaces, each black space being marked by two blue dots. Below this on either side is a broken line of yellow, running from one end to the other, and between this and the feet a space with mottled yellow and black coloring. Below, black and irregular blotches of white on each segment. The caterpillar is covered with long deep yellow hairs coarser and more frequent than the hairs in *C. erosa.* On account of these yellow hairs and the preponderance of yellow in the body, this caterpillar is easily distinguished from the foregoing.

C, constricta: A broad, broken, yellow and black line down middle of back, the line broken by constrictions, forming two irregular quadrangular spaces on each segment. Below this on either side of the caterpillar, a wide blue area containing numerous black spots which are bounded by yellow. Below, on ventral side, a nearly uniform black with indications of light spots in many of the segments. The caterpillars are sparingly covered with yellow and black hairs. This species presents a decidedly blue appearence.

NATURAL ENEMIES.

But few of our birds are tempted by these hairy larvae, but I have observed in a badly infested orchard a flock of Brewer's blackbirds, very common with us, greedily tearing open the cocoons and feeding on the soft pupae within. All three species are attacked by a Tachina parasite which lays eggs on, or in the vicinity of, the head, and its larva, when hatched from the eggs

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bores into and feeds upon the caterpillar's tissues thus eventually killing its host, that is, the caterpillar never transforms to a moth.

Some fungus disease induced by warm wet weather appears disastrious to them, to *C. constricta* at least, for the writer has found them in June, dying and decaying by the hundreds along fences in the neighborhood of oak trees. Chalcid parasites, too, deposit their tiny eggs in these pests and emerge in numbers from the cocoons.

ARTIFICIAL REMEDIES AND METHODS OF PREVENTION.

This subject has been thoroughly discussed in previous bulletins.

Spraying with the arsenites, for the codling moth poisons the leaves and hence kills the leaf-eating caterpillar. Their nests or "tents" with contents, when small and within reach, can be crushed by the hand, and when larger or out of reach can be burned by the application of a torch. It is a noticeable fact that these forms are not so prone to manufacture elaborate nests as the eastern form, *C. americana*. They are frequently found massed on the side of a limb or trunk, thus offering an opportunity to easily kill a large number by the use of a flat stick, piece of shingle or the like.

On the principle, however, that an "ounce of prevention is worth a pound of cure" the most efficacious way of disposing of them is to destroy the egg masses found on twigs in Autumn and Winter, by burning. This may be accomplished by cutting off the twigs upon which the eggs are found and consigning them to the fire; or better, in order to avoid the excessive pruning of small trees which this will entail, break the egg masses, slip them off the twigs and then destroy them. It requires a careful search, or better, several careful searchings to find all the egg masses, but it is by far the most advisable method of proceedure.

The above methods apply to the two forms which infest fruit trees. It would be hardly feasible to practice it against the oak tree form. It is probable, from the large number of diseased individuals of this latter species observed and empty cocoons found that their numbers next year will be very markedly lessened, but from the number of egg masses of *C. erosa* and *C. pluvalis* which can now be seen, it would appear that we may expect them again the coming season.

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The Grain Plant Louse.--*Siphonophora avenae,* Fab.

F. L. WASHBURN.

Almost all of the wheat growing districts in Oregon have been more or less affected this year with the Grain Aphis or Grain Plant Louse, causing the farmer no little anxiety. Many had never before seen anything like it, and were loth to believe that to the grain had come a pest which they were practically powerless to successfully combat. It attacked wheat, oats and rye, and the writer found it on a form of mesquit grass within two miles of the sea-coast, far from any grain field.

Grain badly infested. invariably shrivelled, and millers inform me that its effect is easily seen in the fact that much of the marketed wheat is of an inferior quality.

It is probable that this pest was in the state in limited numbers last year, bnt unnoticed, and the marvellous rapidity with which new individuals are produced will account for the seemingly miraculous invasion. Prof. Fitch, State Entomologist of New York, has proved, by actual experiment, that the females of the grain aphis begin to produce living young when three days old, at the rate of four a day; hence, in three weeks time, eliminating all unfavorable conditions, the descendents from one mother amount to nearly or quite two millions.

The insect is greenish in color, attacking the stalks, and later the heads of wheat, rye, and oats. It has a large beak with which it extracts the sap. This absorption of the sap is what injures the berry. As wheat ripens it migrates to the more succulent oats and when these ripen it goes to the various grasses. It spreads over a wide extent of territory quicker than any insect known.

On the back of the last page of this bulletin is a photograph of some wheat heads badly infested with this pest.

ITS HISTORY.

Although its existence was observed seventeen years before, the grain aphis first appeared in great numbers in 1861, spreading over New England, all of New York except the western portion, northeastern Pennsylvania and portions of Canada. Every grain field was invaded and many of them thronged. In many cases the wheat crop was reduced one-half, and the oat crop hardly paid for harvesting. The following year it spread over the re-

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maining portion of Canada and into Michigan, and then disappeared. In 1883 it appeared in ten counties in California doing considerable damage to wheat, one man reporting that the yield of his spring wheat was diminished one-half by the ravages of the pest. April 29th and 30th and May 2nd and 3rd large flights of the winged variety were noticed in Sacramento, but disappeared after the rains of May 4th. In nearly every instance where the pest has appeared it has been met by a host of parasitical and predaceous insects

ARTIFICIAL REMEDIES.

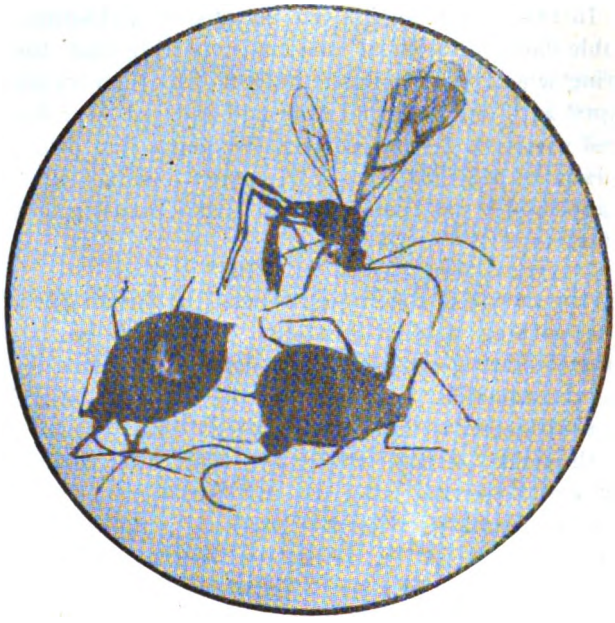
From the nature of the circumstances, the farmer can himself do little or nothing against this pest. It may do no harm to suggest the following measures the value and practiability of which are questionable. 1. Burning the stubble immediately after harvest together with all straw, weeds, litter, waste, etc. on or about the field. 2. Cultivating the land after the crop has been harvested, removing all grass and weeds from around the edge of the field, and growing no grass or grain crop on that piece of land next year. 3. *Wheat and oats which are so badly infested in the green that they very evidently will not ripen can be cut for hay with advantage, Such hay is perfectly acceptable to stock.*

NATURAL ENEMIES.

Under the head of natural enemies occur the "Lady Beetle," or "Lady Bugs" as they are called, Syrphus Flies, "Aphis Lions" and the numerous minute flies which are parasitic on plant lice.

Fortunately, almost simultaneously with an outbreak of this pest appear myriads of these their foes, and as the beneficial forms multiply very rapidly, they greatly reduce the numbers of the lice. It is to these we must look for help, in this crisis and they are about all we can rely upon to lessen the evil. Whenever the aphis turns a dark color, either brown or black, it means that it is doomed. For this is caused by the aphis parasite which deposits its egg on or within the aphis. The egg hatches and the larva feeds on the tissues of the louse causing the death of the latter while the larva turns into a parasitic fly within the aphis. The accompaning illustration represents one of these parasites, about one-eight of an inch long, which has issued from the body of the louse beside it. From the body of the other aphis protrudes the head of a second fly on the point of emerging.

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Parasites [*Aphidius*] emerging from dead Grain Aphids. much enlarged. From a photograph.

As far as personal examination has led me, the species of Lady Beetle attacking this pest is *Hippodamia convergens*. If one goes into an infested field and is on the alert to observe, he will see many of the above; besides varions kinds of Syrphus Flies darting from one wheat head to another, depositing their eggs among the lice. Their worm-like larvae, greenish or brownish, can be counted by the score, snugly ensconced among the aphids and rapidly picking them up and sucking their juices.

I quote from a report by Prof. A. L. Cook, formerly of Michigan, dated July 10th 1889, in order to more fully demonstrate the great value of these insects to the agriculturist. Prof. Cook says: "Ten days ago, June 30th, the heads of wheat were crowded with hungry aphids or plant lice. These myriad lice, often five or six around a single kernel of wheat, and two hundred on a single head, were sucking the sap and very vitality from the forming kernels. They were rapidly blighting the grain, and unless some friendly hand were raised against them

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the wheat crop would be utterly ruined. Even then, when the lice were countless in number, and when the winged forms were rapidly spreading to the oat fields, the hand of deliverance was discerned in the comparatively few but wonderfully prolific enemies of the lice which had already sounded a halt in the march of destruction. A week later and the enemies of the lice were in the ascendancy, and to-day the lice are nearly exterminated, the wheat crop rescued and the oat crop saved. Close observation easily demonstrates these truths. Even the careless eye can see the savage insects dining on the lice, or the fatal egg laid which dooms the larva which receives it." It would appear that excessively wet or excessively dry and hot weather is unfavorable for the grain aphis; for in the first case much rain would chill or kill newly born lice, as well as give the plant abundant nourishment thereby enabling it to withstand attack the better, while excessively warm and dry weather would likewise be fatal to young lice. A medium warm and damp atmosphere is most conducive to the growth and multiplication of all plant lice.

While these insects may, in one season, so reduce the numbers of the Grain Plant Louse, that its attack the following year is hardly appreciable, it may rally sufficiently to cause some injury the second season. Therefore, although there may be no visitation the coming year, it is quite possible its ravages may be felt, after which, if our little friends the Lady Beetles etc., do good work we may expect immunity for many years.

The Pear Leaf Blister.

F. L. WASHBURN.

This affection of the pear leaf is caused by a minute mite, *Phytoptus pyri*, and is probably more common, and has been here longer, than most orchardists realize; in fact, it is very likely that much of that which has been called "blight" on the pear by casual observers, is really the work of this pest. The mite is very small, hardly visible to the naked eye, and is well represented in the accompanying micro-photograph furnished by Mr. Pernot.

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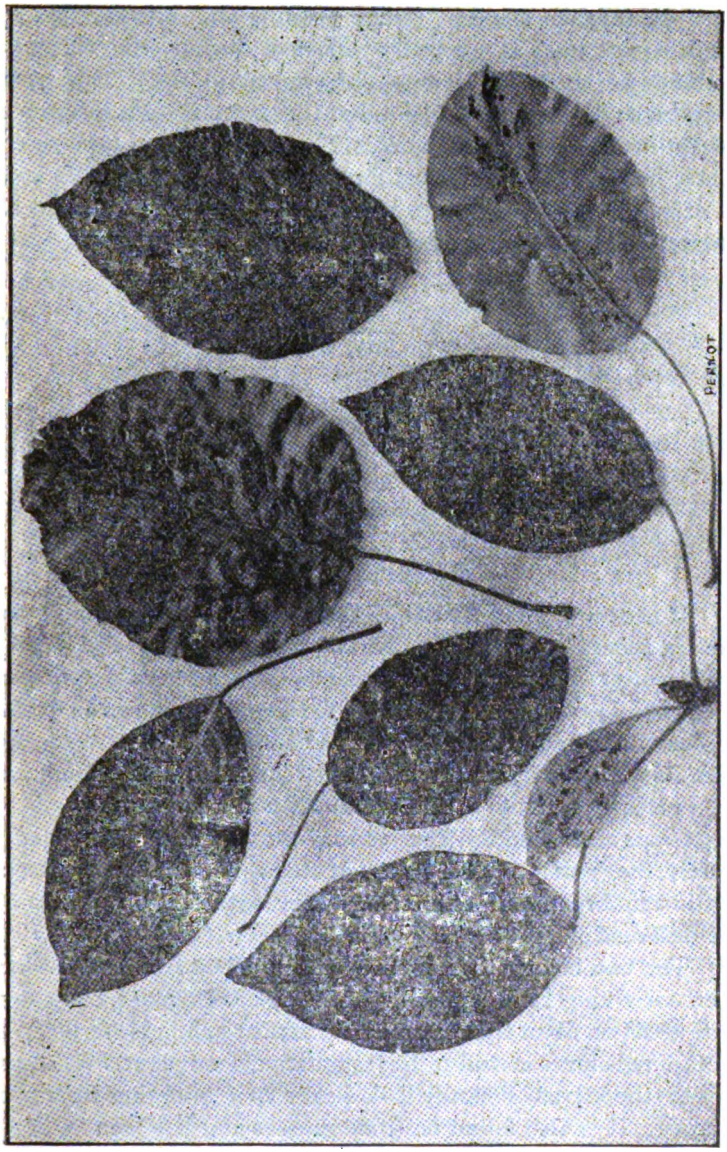
Phytoptus pyri, enlarged about 300 times.

It attacks both sides of the leaf, but individuals are more numerous on the under side where the small "blisters" can be seen with the naked eye. A lense, however, is required to show the opening in the centre of the blister which serves as a doorway for the mite. The location of the injury below is made apparent on the upper surface of the leaf, by an irregular reddish spot, (in the early stages) which changes later to brown and black, while the tissue of the leaf between these two points, in which tissue eggs and young mites are found, becomes corky and dies.

The injury to the tree is more readily seen in the middle and late summer, when, in bad cases, almost its entire foliage looks blighted.

The young mites when hatched spread from leaf to leaf, creating new blisters and thus bringing about the condition referred to above. In the autumn when leaves begin to wither and fall, the mites migrate to the twigs and hibernate beneath scales of bark or bud in the minute crevices on twigs, and in the spring they are fully open. It is hardly necessary to say that this mite saps the vitality of the tree, and interferes with the natural functions of the leaves. The work of this pest is illustrated by the accompanying full page plate, showing views of upper and lower surfaces of leaves.

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REMEDIES.

When a tree is observed to be first attacked, pick off and burn the infected leaves. Heavy pruning and burning the cuttings of such trees as are badly affected, during the winter will probably be more efficacious than anything else. One or two sprayings of kerosene emulsion in the autumn when mites are migrating would destroy many. The same spray, used several times, has been recommended for winter use. It is highly spoken of in a Cornell University bulletin, and is to be used in this proportion,—one part emulsion to seven or eight parts of water.

The Clover Mite.

Bryobia pratensis.—Garman.

F. L. WASHBURN.

It is now evident that this pest is more prevalent in Oregon than is generally supposed. No complaints having been received from growers of clover, the Entomologist has referred specimens of eggs and young mites sent him to the species known as the Red Spider with which this mite is almost identical. But, suspecting from its abundance, that it might be Bryobia, specimens have been recently sent to specialists at Washington D. C. and our suspicions confirmed. The young Clover Mite resembles so closely the young of the so called Red Spider that only specialists in this branch of entomology can satisfactorily determine the difference.

The two belong to the same family, *Tetranychidæ*, and have been for a long time confused. Like the Red Spider, the Clover Mite feeds on plant tissues, infesting almost all kinds of fruit trees, though red clover is said to be its principal food plant. When attacked the leaves of clover look sickly as if suffering from some fungus. It is also found on some grasses and has been known to occur in houses. It was first reported from this coast (California) as early as 1879. May 28, 1889, Mr. E. Shipley of James Val-

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ley P. O., Oregon sent specimens of this mite to Washington D. C. with the statement that it was abundant on boards, stones, fences and fruit trees. It has been found on Apple, Pear, Plum, Prune, Poplar, Elm, Peach, and Almond.

In some localities young mites are found with the eggs during the entire winter season. These eggs are red or reddish, easily seen with the naked eye, and are laid in masses on the bark or beneath the scaly bark of old trees. In the winter they are found by the hundred in protected situations.

When attacking forage crops, it cannot, with our present knowledge, be combatted. When on fruit trees, the Department recommends spraying with kerosene emulsion to which a little sulphur has been added, and when infesting houses the same solution should be used on the lawn and outside walls of the house.

As stated before, no complaint of this pest with regard to clover has been received at our Station. If, at any time, the clover crop should appear to be suffering from the attacks of this mite, the Entomologist would like to be advised of the fact, and to receive specimens of the mite and its work.

Koebele's Resin Wash.

F. L. WASHBURN.

During Mr Kœbele's last visit to Oregon he made, in the Entomological laboratory, some resin wash according to the following recipe: Resin 4lbs., Carbonate of Soda (common washing soda) 3lbs., water 1 gallon; boil together until all the resin is dissolved and then add gradually four gallons of warm water, stirring all the time, and continue the boiling until the mixture is the color of molasses. He recommended its use as follows: for Woolly Aphis 1 part of wash to 6 parts of water, for any other Aphis 1 part wash to 10 or 12 parts of water, for Mealy Bug 1 part of wash to 10 or 12 parts of water.

We have had occasion since then to make and use this wash

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and feel able to indorse all that Mr Koeblelc says in its praises when used against different forms of plant lice.

During his investigations in the hop fields of this state, it was his aim to show the growers the virtues of this wash, claiming it was in many respects better than kerosene emulsion or quassia chips though he by no means denied the efficacy of the last two.

It was his idea that this wash could be used at such a strength that it would kill all the lice and yet not injure the beneficial forms of insects found amongst and feeding on the former. It was a suggestion from him which prompted the Entomologist to begin a series of experiments in this direction. The following is to be regarded as only a preliminary report on this work.

Winged and wingless hop lice were found on plum leaves Oct. 13th. Some of these leaves were immersed in a solution of resin wash and water, one part of the wash to thirty parts of water, for five seconds. After forty-eight hours these leaves were examined and it was found that but comparatively few lice had been killed. One part of the wash to twenty five of water gave the same results. One part wash to fifteen parts of water was then used and all the lice so treated were dead when leaves were examined a few hours later. Naturally one part of wash to ten and twelve parts water respectively was equally efficacious.

Attention was then directed to the effect of these strengths upon the predaceous insects found with hop lice. One part of the wash to fifteen of water did not effect the larvæ of Syrphus flies, and only induced a temporary disability on the part of the larvæ and imagos of the Coccinellidae "Lady Beetles". One part of the wash to eight parts of water (10-20 seconds immersion) killed both Coccinellidae larvæ and imagos but did not seriously inconvenience the Syrphus larvae, which can stand, as found later, a solution of one part of the wash to six of water, without succumbing.

It would appear, then, that one part of the wash to fifteen of water can be used against hop lice without endangering either of the above two predaceous insects in company with them.

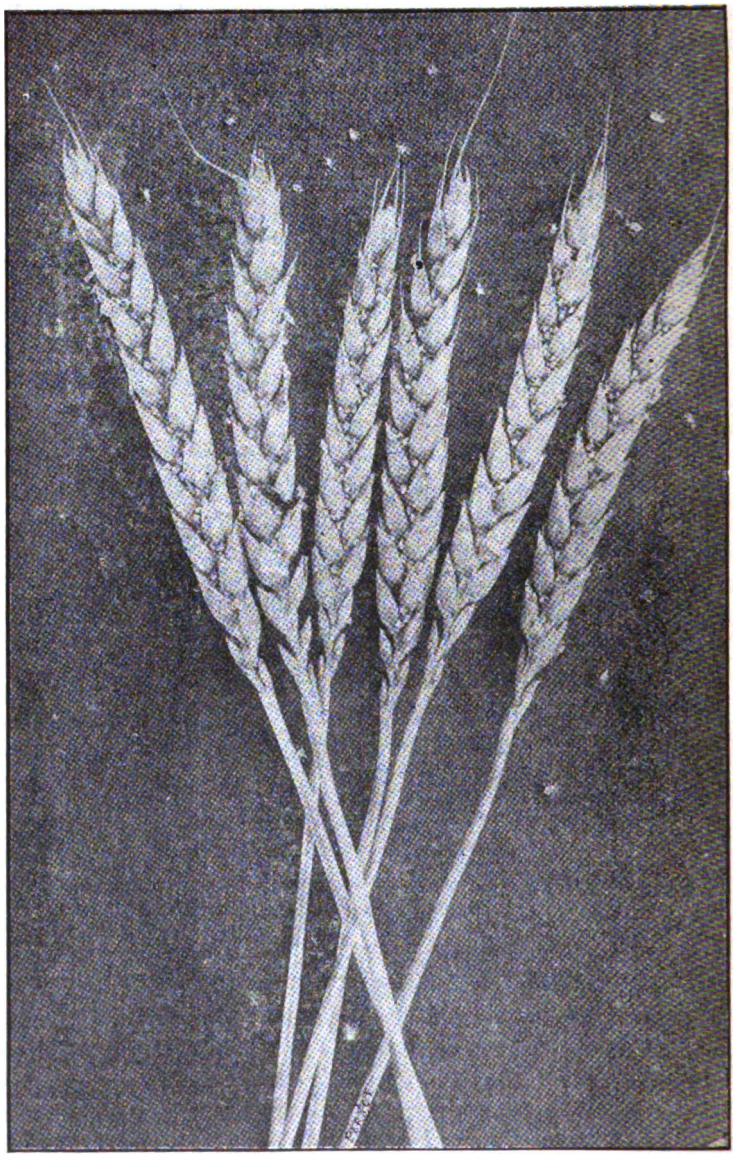
Of course, the test in the field would not be as rigid as in the

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laboratory; in other words, neither the lice nor the beneficial insect would be immersed so completely or for so long a time, by the spray. Hence one part to twelve could probably be used with safety, and perhaps with greater efficacy as far as the lice are concerned. By reference to the first part of this article it will be seen that this strength, 1 part to 10 or 12 of water, is exactly what Mr Koeblele recommends for all forms of plant lice except Woolly Aphis.

All illustrations in this bulletin have been prepared by Mr. Pernot in charge of our Photographic department

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Heads of Wheat infested with Grain Plant Louse; on one head a larva of Syrphus fly can be indistinctly seen feeding on the lice.

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Oregon Agricultural Experiment Station.

Bulletin No. 34. February, 1895.



HORTICULTURE.

FRUITS AND VEGETABLES.

Notes on the Comparative date of Blooming, and Pollen production of varieties of Apples, Pears, Plums, and Cherries.

The Bulletins of this Station are sent free to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE
H. R. CLARK, Manager,
CORVALLIS, OREGON
1895.

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FRUITS.

POLLINATION.

GEORGE COOTE.

The first step towards successful fruit culture is an orchard wisely planted. The several varieties must be so located that each may assist in the pollination of one another. This can only be done by a careful study of the different varieties as to their time of blooming and amount of pollen produced by each variety.

Very careful observations and notes were taken on all varieties on the college farm. It will be understood that all varieties of fruit trees do not have the same power of producing pollen. If a large number of trees of a single variety be planted which are shy pollen producers the lack of pollen will undoubtedly cause a failure in the crop of fruit; and this danger of failure will be greatly increased if the weather is damp at the time of blooming.

The pollen is conveyed from flower to flower by bees and other insects. Their object is the discovery of honey; and whilst searching the recesses of the flower they unintentionly cover their bodies with pollen which they convey to the next flower and unadvoidably deposit it on its stigma. If the amount of pollen produced be small there will be but a small amount to be distributed and the fertilization of each flower would be either a failure or imperfect. This shows the necessity of planting trees which are shy producers of pollen along with those rich in pollen. Hence to arrange the trees in an orchard it is necessary to know the pollen producing powers of each variety.

It will be seen that the list of varieties in the following tables is comparatively small. But it must be remembered that this is but a beginning of a work which must be continued through a series of years. We have many other varieties on the college grounds which have not yet come into bearing, and hence are not reported.

As soon as a report of all varieties can be made, a classification will be made and published for the benefit of all interested in such work. The following table shows the date of blooming and pollen producing power of each variety.

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Comparative Notes on the Date of Blooming, and Pollen Production of Varieties of Fruit.

CHERRIES.

No.	NAME.	Date of first bloom.	Date of full bloom.	Date of Pollen maturing	Date of stigma receptive
1	*Black Republican,	4.13	4.18	4 20	4.20
2	†Bigarreau (Rockport)	4.17	4.20	4.21	4.21
3	†Bing	4.18	4 21	4.21	4.21
4	*Black Tartarian	4.19	4.23	4.24	4.24
5	*Coe's Transparent	4.19	4.27	4.28	4 28
6	*Centennial	4.13	4.19	4.20	4.20
7	*Early Purple Guigne	4.22	4.24	4.25	4'25
8	*Elton	4.11	4.20	4.21	4.21
9	*Governor Wood	4.16	4.19	4.20	4.20
10	*Great Bigarreau	4.14	4.18	4.20	4.20
11	†Kentish	4.21	5.05	5.06	5.06
12	†Knights Early Black	4.19	4.25	4.26	4.26
13	*Lincoln	4.18	4.24	4.25	4.25
14	†Late Duke	4.20	5.07	5.08	5.08
15	†Lewelling	4 14	4.23	4.23	4.23
16	*Leibe	4.16	4.19	4.20	4.20
17	*Major Francis	4.18	4.24	4.20	4.20
18	‡May Duke	4.20	5.03	5.04	5.04
19	*Royal Ann, Napoleon Bigarreau	4.17	4.23	4.23	4.23
20	*Williamette	4,18	4.21	4.21	4.21
21	†Yellow Spanish	4.14	4.18	4.21	4.21

PLUMS.

1	*Chabot	3.31	4.02	4.02	4.04
2	†Coe's Golden Drop	4.08	4.10	4.12	4.12
3	*Columbia	4.14	4.24	4.24	4.24
4	‡Botan or Abundance	4.10	4.19	4.21	4.21
5	‡Myrobalan	3.23	3.31	4.02	4.02
6	*Jefferson	4.06	4.09	4.10	4.10
7	*Goliath	4.06	4.10	4.11	4.11
8	‡Satsuma or Blood	3.25	4.16	4.26	4.26
9	†McLaughlin	4.06	4.10	4.11	4.11
10	†Imperial Gage	4.09	4.11	4.18	4.18
11	†Washington	4.09	4.13	4.15	4.15
12	‡Ickworth	4.11	4.19	4.20	4.20
13	†Quackenboss	4.11	4.19	4.20	4.20
14	*Peach Plum	4.13	4.20	4.21	4.21
15	†Sherman	4.13	4.21	4.22	4.22
16	†Walling	4.12	4.16	4.17	4.17
17	‡Yellow Gage	4.08	4.11	4.12	4.13
18	*Rhine Claud	4.07	4.12	4.14	4.14
19	*Smith's Orleans	4.07	4.18	4.19	4.19
20	†Masu	4.14	4.20	4.21	4.21
21	†St. Julian	4 19	4.23	4.24	4.24
22	‡Orange	4.07	4.10	4.12	4.12
23	†Yellow Jap	4.09	4.16	4.17	4.17
24	‡Royal Hative	4.06	4.18	4.25	4.25
25	†Simon Plum	3.22	4.04	4.06	4.06
26	*Petite Prune	4.11	4.19	4.20	4.20
27	†German Prune	4.13	4.19	4.19	4.19
28	†Italian	4.19	4.25	4.28	4.28

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PEACHES.

No.	NAME.	Date of first bloom.	Date of full bloom.	Date of Pollen maturing	Date of stigma receptive
1	*Clements	4.02	4.09	4.10	4.10
2	‡Austin Cling	4.08	4.15	4.16	4.16
3	†Alexander	4.10	4.20	4.21	4.21
4	†Bishop's Early	4.07	4.13	4.15	4.15
5	†Corvet	4.05	4.09	4.10	4.11
6	*Ellson	4.07	4 12	4.14	4.14
7	†Elberta	4.07	4.12	4.14	4.14
8	*Miss Lola	4.06	4.09	4.10	4.10
9	*Ulates	4.02	4.09	4.10	4.10
10	‡Late Crawford	4.03	4.11	4.12	4.12
11	*Mother Porter	4.06	4.09	4.10	4.10
	PEARS.				
1	*Bartlett	4.20	4.25	4.26	4.26
2	*Beurre Gifford	4.12	4.18	4.19	4.19
3	†Beurre 'd Anjou	4.13	4 17	4.19	4.19
4	†Duchess 'd Angouleme	4 10	4.19	4.20	4.20
5	‡Keiffer's Hybrid	3.29	4.04	4.05	4.05
6	†Pound	4.16	4.23	4.24	4.24
7	‡Idaho	4.13	4.17	4.18	4.18
8	†Barry P	4.14	4.24	4.24	4.24
9	*Beurre Clairgeau	4.16	4.23	4.24	4.24
10	†Seckel	4.18	4.22	4.22	4.22
11	*Winter Nellis	4.18	4.24	4.25	4.25
12	*Summer Doyenne	4.09	4.17	4.19	4.19
13	‡Osborn's Summer	4.19	4.22	4.23	4.23
14	*Le conte	3.31	4.06	4.10	4.10
	APPLES.				
1	*Baldwin	4.24	5.04	5.05	5.05
2	†Charlotenthaler	4.24	5.03	5.03	5.03
3	*Domini	4.24	5.01	5.01	5.01
4	†Early Harvest	4.23	5.07	5.08	5.08
5	*Fall Pippin	4.26	5.07	5,08	5.08
9	†Grimes Golden	5.01	5.09	5.10	5.10
7	†L. Romanite	5.11	5.22	5.23	5.23
8	†Missouri Pippin	5.01	5.06	5.07	5.07
9	†May of Myers	5.07	5.11	5.12	5.12
10	†Oldenburgh	4,30	5.06	5.07	5.07
11	*Pumpkin Russet	5.03	5.07	5.07	5.07
12	*Oregon Crab, (Lewelling)	4.19	4.25	4.26	4.26
13	‡Rambo	4.26	5.08	5.09	5.09
14	†Rome Beauty	5.13	5.22	5.23	5.23
15	*Tetofsky	4.24	5.07	5.08	5.08
16	†Transcendent, Crab	4.20	5.02	5.03	5.03
17	‡Winesap	4.28	5.10	5.11	5.11
18	†Waxen	4.21	4.30	4.30	4.30
19	*Whitney No. 20, Crab	4.26	5.06	5.06	5.06
20	†Martha, Crab	5.03	5.11	5.11	5.11
21	*Hyslop, Crab	4.25	5.04	5.05	5.05
22	*Yellow Siberian, Crab	4 23	4.30	4.30	4.30

N. B.—Varieties marked with a * are abundant in pollen; those marked with a † are medium: those marked thus ‡ are scant of pollen.

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Experiments in Pollination of the Peach.

When the peach is grown in glass houses, and forced by artificial heat out of its season, it is necessary to pollenize the stigma of each flower by artificial means either by a small brush or some other process. The use of the brush is expensive and tedious and is not always successful; much of the fruit dropping at the stoning period.

To save labor in transferring the pollen some trees were sprayed when in full bloom with warm, and others with cold water. This proved very unsatisfactory, more fruit dropping at the stoning period than in the case of trees pollenized with the brush.

As a further experiment a hive of bees was placed in the house when the trees commenced to bloom. This was in November, and a heavy fog prevailed for fifteen days, and although the flowers were constantly opening not a bee showed itself. During the night of the fifteenth the fog lifted and the next morning was bright and clear, causing the pollen to burst Then the bees came from the hive and kept up their work for eight or nine days. The result was that not a single peach was observed to drop at the stoning season. So great was the amount of fruit on the trees that it was necessary to thin it. One tree in the house was securely protected, so that bees could not gain access to it, and all of the fruit dropped at the stoning period.

These facts show the value of bees to the horticulturist, and no fruit grower should be without them

Varieties of Apples Tested.

The experimental orchard was planted in the spring of 1891. The soil is a basaltic loam. It had been in wheat and oats for many years without the application of fertilizers of any kind. Before planting the trees the soil was plowed and subsoiled. Cultivation of the soil has been kept up all through the growing season; under this treatment the trees are making rapid growth. So far but few have fruited. There are now one hundred and thirty varieties of apples, and nine of crabs growing on the ground and others will be added as fast as means will premit.

NOTES ON VARIETIES OF APPLES AND CRABS PLANTED 1891, (ONE YEAR FROM THE GRAFT, WHEN SET.)

HYSLOP CRAB.—Fruit large, borne in clusters of three to four, roundish to egged shaped; color a dark, rich red; covered with a thick blue bloom. Flesh yellowish, good for cooking. Tree, a strong grower; spreading. A long keeper. Productive.

WHITNEY NO. 20 CRAB.—Fruit light yellow; skin glossy, streaked with carmine; flesh tender, juicy, pleasant flavor. Matured the 26th of Aug. Leaves dark green, glossy. Tree of uniform growth. Very productive. Not a long keeper.

MARTHA CRAB: Fruit large, yellow shaded and streaked with light red, good quality; good for eating out of hand. Ripened Sept. 28th. Tree makes a medium growth.

YELLOW SIBERIAN CRAB.—Color, bright yellow. Fruit inclined to oval in shape, somewhat larger than the common Siberian; good for preserves and jellies. Matured Sept. 6th.

YELLOW TRANSPARENT CRAB.—Pale yellow, medium to large, flatten-

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ed, slightly conical. Flesh white, tender, juicy; slightly sub-acid. Matured Aug. 15th. Tree an upright grower; vigorons and productive. Will keep but a few days.

TETOFSKY.—A Russian variety; early, productive. Tree spreading, forming an open head. Trees are susceptible to injury by frost. Fruit of medium size; oblate,conical, often nearly round; yellow, striped with red and covered with a whitish bloom. Flesh white, juicy; slightly acid. Matured Aug. 15th.

OLDENBURGH.—Origin, Russia. Tree a vigorous grower; upright spreading head; producing when quite young. Fruit valuable for cooking, large, regular in form; roundish, oblate. Skin smooth, faintly splashed and streaked with red on a golden yellow ground. Calyx rather large, nearly closed, set in a wide, even basin. It has a faint blue bloom on the fruit. Flesh juicy, slightly sub-acid. Matured Aug. 27th

MAY OF MYERS—Tree of medium growth producing when quite young. Fruit medium size, roundish, conical. pale greenish yellow, streaked with carmine in the sun; flesh white, very fine grained, firm. Not very juicy. Flavor mild sub-acid. Good Feb. to June.

LITTLE ROMANITE.—Tree hardy, vigorous grower; bears quite young. Fruit, medium in size, roundish oblong. Skin smooth, streaked with deep red and yellow. Stalk short, deeply inserted; basin deep. Flesh yellow, firm, juicy and rich. Very good. Season: Feb. to May.

Cherries.

BING.—Fruit very large, heart shaped, slightlv angular, surface glossy; color, dark crimson to black. Cavity broad, stem rather long, broad suture, slightly depressed at apex. Skin thick; firm, sweet. Flavor good, and of excellent quality. Matured July 6th

LATE DUKE.—Fruit large, roundish, heart shaped; stalk from 1½ to 2 in. in length. Color, bright shining red. Flesh amber, tender, juicy and rich. More acid than May Duke. From its color and softness is apt to be gathered before maturing, which would be for this locality the second week in Sept. The tree makes a vigorous growth, with a spreading habit, while the May Duke is quite the opposite, the latter making an erect growth.

MAY DUKE.—Fruit large, roundish, stalk long and slender. Color, dark red, when fully exposed to the sun. Flesh tender, juicy, rich. The tree may be readily distinguished by its upright growth. Matured June 30.

ELTON.—Fruit large, heart shaped; less obtuse than that of the Bigarreau It has a longer and more slender stalk, being from 2¼ to 2½ inches in length. Skin of a pale waxy yellow on the shaded side; mottled and streaked with red next to the sun. Flesh whitish, firm, sugary and very rich. Matured July 20th. Tree makes a strong spreading growth, branches dark brown; shoots speckled with a silvery epidermis on a ground of chestnut brown. Leaves very large.

BIGARREAU NAPOLEON, (Royal Ann.)—Fruit large, heart shaped; light yellow, spotted with deep red and dark crimson, flesh firm, juicy, flavor good. Tree makes a vigorous growth. Matured July 15th.

Plums.

BOTAN OR ABUNDANCE.—Medium in size, quite pointed, and in many cases oblique, Color yellow, slightly covered with red on the sunny side; flesh deep yellow, juicy. When fully matured is of good quality. Tree a strong upright grower; leaves narrow. Matured Sept. 5th. Cling.

SATSUMA OR BLOOD.—Size medium to large. Conical and quite pointed.

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Deep suture; color dark red; flesh dark blood red. Coarse, slightly acid, of fair quality, clinging to the stone quite firmly. It blooms early, and is often killed by late frost.

GOLIATH.—Fruit large, roundish oblong, a little depressed. Stalk downy; skin purple, covered with a rich bloom. Flesh greenish yellow, firm, coarse; adhering to the stone: only medium in richness. Good for cooking.

ROYAL HATIVE.—Fruit, medium size, roundish, rather widest near the stalk which is about ½ in. in length; but little depression at its insertion. Skin purple, netted with yellowish brown. Flesh yellow, rich and delicious. Productive. Matured Aug. 12th.

ORLEANS.—Fruit, medium to large, depressed at apex. Stalk ½ in. in length. Ground color of the skin is a dark purplish red, with pale red specks; covered with a good bloom giving it a blue color. Flesh, yellowish green, firm; very small free stone. Good for cooking.

Grapes.

CENTENNIAL.—The vine has made a medium growth; berries not large; skin firm; color very light green, shaded with pink; flesh juicy, sweet. Matured fruit Oct. 10.

ROYAL MUSCADINE.—Syn. common Muscadine, White Chasselas.—Bunch medium size, tapering, occasionally shouldered. Berries of medium size, sound; skin thin. When fully matured assuming an amber tint. Flesh tender, rich and sugary. Very productive, sets very evenly. One of the best in cultivation.

TELEGRAPH.—Berries large, round to oval; color dark. Failed to mature; is not adapted to this climate. The vine makes a very strong growth.

WILDER.—Bunches large, shouldered; berry large, somewhat globular; quite dark; flesh tender, juicy and sweet. Matured Sept. 29th. The vine is vigorous and quite healthy.

LADY.—Vine makes a small growth. Foliage resembles Concord. Bunches small, quality good. Color light greenish yellow, covered with a heavy bloom; skin very thin; pulp tender, sweet and rich, slightly vinous.

GOETHE, (Rogers No. 1.)—Vine a vigorous grower. Bunches large, of a loose habit, shouldered; berries large, oblong, yellowish green, small red dots on the sunny side; skin thin. A late variety, did not mature.

PRENTISS.—Vine of medium growth, short jointed; large leaves, downy. Bunches medium, not shouldered. Berry round, somewhat inclined to oval. Skin, thick, firm; color light green to pale yellow when fully ripe with a slight pinkish tint on the sunny side: covered with a weak bloom. Matured Sept 29th.

JESSICA.—Vine makes only a medium growth. Small, compact bunches. Berries, medium size; color, a light green changing to amber when matured; skin thin; pulp, tender, very sweet and sugary. Matured Sept. 20th.

GREEN MOUNTAIN.—This variety was received from Steven Hoyt & Co., New Cannan Conn., for trial. It has been in bearing two years and has proved to be a valuable addition to the list of white grapes. It is very productive; matures early; and so far is quite free from disease. It is one of the most valuable varieties for this coast, especialy for the valley districts. Vine a medium grower, close jointed, bunches large sometimes shouldered; compact; skin of medium thickness, rather dark green in color, covered with a whitish bloom. Flesh tender, rich and of excellent quality.

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ERIE BLACKBERRY.

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SWEET WATER.—Vine short jointed, leaves glossy, and deep green above, pubescent beneath, reddish brown when first beginning to unfold. Bunches quite large, open. Berries large, round; color light green. with a slight brown next the sun; flesh sweet and rich; quite productive. Matured Nov. 2d.

LINDLEY, (Rogers No. 6.)—Vine makes a vigorous growth. Bunches large, shouldered, loose; berries large, round; color brick red; flesh tender, sweet, with a considerable Muscat flavor; fruit drops from the clusters very soon after maturing. Matured Oct. 5th.

WORDEN.—Vine makes a weak growth. Bunch of medium size; shouldered; berry large, black; skin thin; flesh sweet resembling Concord. Matnred Oct. 29th

ULSTER'S PROLIFIC.—Vine, a medium grower. Bunches medium; berries large; thin skin; flesh tender, sweet with a slight flavor of the Muscat. Matured Oct. 4th.

CONCORD MUSCAT.—A very strong vine. Bunches of medium length, compact; berries large, oval; skin thin; color, light green with a small amount of bloom; flesh quite tender; flavor rich and sugary with a strong Muscat flavor. Matured Oct. 1st.

HERBERT (Roger's No. 44).—The vine makes a vigorous growth, healthy; producing medium sized bunches, often shouldered; slightly compact; berries of medium size, color black; flesh quite tender and sweet, of excellent quality; matured Oct. 29th.

Blackberries.

For the purpose of making a comparative test of Blackberries and Raspberries, three plants of each variety were taken, consisting of four canes each. The weight of the fruit was carefully recorded at each gathering.

AGAWAM.—Fruit sweet, melting, medium size; quite black; firm; first bloom opened May 25th, full bloom June 3rd; first picking July 11th, last picking Aug. 27th; three plants producing 7 lbs.; canes are of medium growth.

ERIE.—Fruit quite large; diameter 1 in. circumference 3½; firm, and of excellent flavor; good for shipping. First bloom May 29; full bloom June 6th; first picking July 25; last picking Aug. 27th; three plants producing 16 lb; canes make a very strong growth.

CHILD'S TREE.—Fruit almost round, ¾ by ⅝ inches; flavor good; has not proved productive.

TAYLOR'S PROLIFIC.—Fruit large, and quite glossy; quality good; 1 in. in diameter, 3 in. in circumference. First bloom opened May 26th; full bloom, June 3d; first picking, July 11th, last gathering, Aug. 27th: three plants produced 5 pounds.. Makes a strong growth.

SNYDER.—Fruit, medium size: quality, good; diameter, ⅝ in.; circumference, ⅞ in.; firm; first bloom opened May 24th; full bloom, June 2d; first gathering, July 24th; last gathering, Aug. 27th. Three plants produced 5 lbs; canes quite vigorous, producing large leaves.

WILSON JUNIOR.—Fruit large, firm; excellent flavor; diameter ¼ to ⅝ in.; circumfereuce 1¼ in. First ripe fruit, July 24th; last gathering, Aug. 8th. Three plants producing 3 lbs.; cane made a small growth.

EARLY HARVEST.—Fruit good quality, firm; medium in size; first bloom May 27th; full bloom, June 4th; first gathering, July 18th; last gathering, August 6th. The canes make a strong growth. Cannot recomend them for

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planting for general cultivation. The canes are not hardy. Much damaged by frost; three plants produced ¼ lb.

KITTATINNY.—Fruit large; diameter 11-16 inches, circumference 2¾; firm, good quality; First bloom, May 28th; full bloom, June 6th; First picking, July 25 th; last picking, Aug. 22 nd; three plants produced 12 lbs.; canes extra strong, a good market variety.

OREGON EVERGREEN.—*Rubus laciniatus*, Willd.—Fruit large; medium in quality; juicy. If grown without irrigation the seeds are quite hard; is very productive; strong growing; quite hardy. This variety when properly cultivated needs to be irrigated, the fruit will be of better quality and much more productive. The plants in question were grown without water. The first gathering was made Aug. 4th; last gathering Sept. 20th; product of three plants, 120 lb.

Raspberries.

GOLDEN QUEEN (Childs).—Fruit, yellow; large, measuring 1½ to 2½ in. in circumference; of good flavor; firm; good shipper; very attractive when mixed with the red, for desert. First bloom opened May 23d, full bloom, June 4th; first ripe fruit, June 30th, last picking, Aug. 1st; three plants produced 5 lb; canes made a vigorous growth; long jointed. Produce suckers very freely.

CHILDS ALL SUMMER (Childs,).—Fruit dark red; large; circumfrence of fruit, 2½ to 2¾ in; quality good; an excellent berry for market. First bloom, May 1; full bloom, May 24; first ripe fruit, June 30; last picking, Sept. 8; three plants producing 10 lbs. canes vigorous, short jointed; leaves large, quite dark in color.

CUTHBERT—Fruit, bright red; moderately firm; of good quality; circumference of fruit, 2½ to 3½ in.; flavor sweet and lucious; a good shipper. First bloom opened May 11th, full bloom, June 2d.; first ripe fruit, June 20th; three plants broducing 12 lb; last picking, Aug. 17th; the best red raspberry for all purposes tested here. Canes make a medium growth; quite healthy.

TURNER.—Fruit red; above medium size; circumference 1½ to 2½ in.; flavor not of the best; good shipper; first bloom opened May 14th; full bloom, June 3d.; first picking, 23d.; canes not strong; 3 plants produced 5½ lbs; last picking, July 27th.

CRIMSON BEAUTY.—Fruit red, small; does not adhere to the stem well. Not a success this season. First bloom May 20, full bloom June 1; first picking June 27; three plants producing 3 lbs. Canes qnite short; leaves small, turning yellow by Juue 30th.

MARLBORO.—Fruit red; medium in size, 2½ in. in circumference quality good; firm; first bloom opened, May 27; full bloom, June 6th; first picking July 2; three plants produced 5 lbs.; last picking, July 31. Canes strong, long jointed.

SHAFFERS COLOSSAL;—Fruit, dull purple; large, 2¼ in. in circumference, ⅝ in. in diameter; flavor good. First bloom opened, May 21; full bloom, June 5; first picking, July 2; last, July 27; one plant prodnced 1 lb. 1 oz; canes small, not in good condition for bearing.

EARLY PROLIFIC.—Fruit red; firm; 2½ in. in circumference. ⅝ in. in diameter; flavor good; first bloom, May 21, full bloom, June 2; first picking, June 26, last picking, June 25; three plants produced 4½ lbs. Canes of medium growth.

HANSELL.—Fruit very red, firm; 2½ in. in circumference, ⅝ in. diameter; quality fair; first bloom, May 12, full bloom, May 29; first picking; June 26, last picking, June 27; three plants producing five lbs. Canes not over strong.

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EVERGREEN BLACKBERRY.—(*Rubus laciniatus,*) Willd.

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Black Caps.

DOOLITTLE.—Fruit a dark purple; 2 in. in circumference, 9-16 in. diameter; flavor sub-acid; much esteemed for cooking. First bloom, May 22; full bloom, June 3d; first picking, June 30; last picking, July 27; three plants producing 6 lbs 3 oz. Canes quite strong.

NATIVE VARIETY (*Rubus lucodermus.*)—Fruit, quite large; diameter ⅝ in., circumference 2½ in.; flavor excellent; first picking, July 9th; three plants producing 5 lbs. 3 oz. Canes very strong growing.

SOUHEGAN.—Fruit, quite dark, having a large amount of bloom; diameter, ⅝ in., circumference, 2½ in.; quite a pleasant flavor; firm; first bloom, May 23; full bloom, June 2; first ripe fruit, June 26; last picking, July 25; three plants producing 10 lbs. Canes very strong.

JAPAN WINEBERRY.—Fruit dark red; diameter ⅝ in.; circumference 2⅛ in.; first bloom, July 16; first picking, July 30; last picking, Aug. 22; three plants producing 7 lbs.; the calyx is covered with a glutinous substance. Canes are set very thickly with small dark red spines.

Cherry or Pear Slug, (*Selandria cerasi.*—Peck.)

On July 4th, the slug commenced to attack the Pear and Cherry trees. They were found in greater numbers on the latter. The trees were liberally dusted with air-slacked lime. It was thrown from the hand into the trees, the operator taking care to stand to the windward side, so that the lime might be better distributed among the branches.

The slugs being naturally moist the lime readily adheres to them, and the smallest particle seemed to make them commence to curl up, and to cause them to fall to the ground.

As an experiment, earth dust was used on a few trees. Two days after these applications, the orchard was inspected. It was found that trees that were treated with the lime were comparatively free from the slugs, while those receiving the application of earth dust were badly infested.

The lime should be applied early in the morning before the dew is off. After the treatment the trees put on a very healthy appearance.

NOTES ON VEGETABLES.

A number of novelties, and standard varieties of vegetable seed were received from Atlee, Burpee & Co.; also from Possen & Son, for the purpose of comparing them upon our Experiment ground. These plats have been heavily fertilized with stable manure so that the soil has become better suited to this work.

Peas.

RENOWN (Burpee.)—Vine, medium strength; 2 to 2½ feet high; slightly branched; color, dark green; leaflets 4 to 6; good quality; evenly filled. Pods 3¼ x ⅝.

ECHO (Burpee.)—Vines of medium growth, 2 to 2½ feet high; 4 leaflets; color, dark green; paired; pod 3¾ x ⅞; number of peas in pod, 5 to 6, well filled and of excellent quality.

VICK'S PERFECTION (Bowen,)—Vines strong, 2 to 2½ feet high; not

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branching; color dark green; leaflets 4 to 6. Pods paired; 5 to 8 peas in a pod; 2½ x ½ in.

BLUE PETER (Possen.)—Vines 10 to 12 in. high; strong growth; early, prolific; color dark green. Pods 3 x ⅝ in.

EARLIEST OF ALL (Bowen.)—Vines make a slender growth, 16 to 24 in. high; Color light green; leaflets 4; 3 to 6 peas in a pod, 2½ x ½. An early variety.

Radishes.

GOLDEN DRESDEN.—A new variety, introduced by Atlee, Burpee, & Co. Philadelphia. Seed was sown in open ground April 23d.; marketable maturity, May 24; thirty-two days from time of sowing; producing large well formed roots; color, light golden brown; flesh quite white and crisp; of good flavor; a valuable addition to the long list of varieties.

NEW IMPERIAL FRENCH BREAKFAST RADISH (Burpee.)—Seed sown in open ground April 23; producing very attractive roots; red tipped with white; olive shape; tender and crisp; an excellent early variety.

Corn.

EARLY FORDHOOK SWEET CORN (Burpee.)—A very early, dwarf growing variety; quite productive; maturing from three to four medium sized ears to the stalk; is of the finest quality; a valuable early variety; maturing five days in advance of Cory; height 3 to 4 feet.

Lettuce.

ICE-BERG (Burpee.)—A quick growing variety, producing large solid heads; crisp and tender; stands a long time before going to seed; good quality.

FERRY'S EARLY PRIZE HEAD (Posson.)—This variety produced well during the summer; head quite large, the tips of the leaves changing to a bronze color; quite tender and crisp; average weight of head 11 oz.

BIG BOSTON (Henderson.)—A variety resembling Boston Market, with the exception that it grows larger in size; six to eight days later in maturing; head weighing from 8 oz. to 1¼ lb.; medium quality, good for market purposes

NEW CELERY LETTUCE, Trianon, (Henderson,) Syn; Paris white Cos.—Large pale green leaves which fold over at the top so that they close over and blanch without tying; heart very white and crisp; excellent quality; continued growing longer than any other variety on the grounds. It proved to be one of the best summer varieties grown here the past season.

NEW WHITE GIANT, COS (Burpee.)—Resembling the above; is strong growing; standing a long time before going to seed; produces large white hearts; tender, crisp and of good quality.

WHEELERS TOM THUMB (Burpee.)—Forms a small hard head; produces but few outer leaves; can be planted much closer than other varieties; excellent quality; quite hardy in the Willamette Valley; can be highly recommended for planting out in the fall for early spring use.

EARLY WHITE SELF-FOLDING (Posson) Syn.—Paris white.

PRICKLY SPINACH (Posson.)—A variety for autumn sowing; and may be readily distinguished by its seeds being quite prickly; it is much hardier

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than the round or summer spinach. If sown the middle of August, the plants will produce frequent gatherings all through the Winter months and early Spring. The soil should be well drained for the production of Winter spinach.

Victoria Spinach (Burpee.)—A strong growing and productive variety; remaining in season a long time, leaves quite large; good quality,

Bloomsdale Spinach (U. S, Dept. Agri.)—Made a good growth; remaining in use but a short time; went to seed early; marketable maturity, July 6th; ripening seed, Aug. 10.

Beans.

Extra Early Refuge (Posson.)—Vines 8 to 10 in. high, erect; bushy; pink bloom; pods 3 to 4½ in. long, ⅜ in. wide; color green, with a few purple specks; leaves medium size; two to four beans in a pod; not filled to the end.

Golden Wax (Posson.)—Vines 10 to 12 inches high; strong, erect; dark green; leaves medium in size; flower white; pods yellow; 3 to 4½ in. long, ½ in. broad, flat; 3 to 5 beans in a pod; very prolific.

Golden Champion (Possen.)—Pole; vine of medium strength; leaves light green; flowers pink; pods 4 to 6 in. long, ⅜ in. wide; roundish; string slightly developed; prolific,

Speckled Wax (Posson.)—Plant 6 to 10 in. high, erect; leaves small, light green tinged with yellow; flowers pink; pods 3 to 5 in. long, ½ in. broad; yellow, spotted with red; slightly curved; 3 to 5 beans in a pod; first picking July 25th.

Burpees Bush Lima (Burpee.)—Plant, 10 to 14 in. high, of medium strength; leaves medium size; flowers white; pod 3 to 5 in. long, 1 to 1½ in. broad; one to three beans in a pod; of excellent quality.

Burpee's New Stringless Green Pod Bush Lima (Burpee.)—Plant 10 to 12 in. high, erect, leaves medium size; flower white; Pods 3½ to 5 in. long ½ in. broad; producing from 2 to 5 beans in a pod; color green; without strings; prolific; maturing July 17th.

Willow Leaf Lima (Burpee.)—Vine strong growing, 5 to 7 feet high; flower white; prolific, season late; pods 3 to 3½ in. long, ⅝ wide; producing from 3 to 5 beans in a pod.

Horticultural Lima (Possen.)—Pole; leaves large, dark green; flowers white; pods 4 to 5 in. long, ⅝ broad, splashed with red when nearing maturity; 3 to 6 beans in a pod.

Early Black Lima (Burpee.)—Pole; 4 to 7 feet high, of medium strength; season late, prolific; flowers white; pods 2½ to 3½ in. long, ¾ wide; 2 to 3 beans in a pod.

Southern Prolific (Bowen.)—Pole, 6 to 8 feet high; pods borne in clusters; very prolific, valuable late variety; producing pods of the best quality until cut by frost.

Cauliflower.

Burpee's Early Cauliflower (Burpee.)—Plants make a compact growth; heads are well protected; producing compact solid heads of excellent quality; quite white; stem short; matures early.

Veitches Autumn Giant (Henderson.)—Heads large, compact; white,

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good quality. It is unduobtedly the best autumn cauliflower yet introduced for this locality for winter use. If sown the last week in April or the first week in May, and planted in well manured ground it will begin to mature the last week in October, and continue to do so through Nov., Dec., and Jan., should the weather permit. It has been grown on the Station grounds six years often producing heads from 8 to 9 lbs. in weight.

Pumpkins.

FORDHOOK (Burpee.)—A strong and rapid growing variety of the best quality; prolific; light lemon yellow; good keeper; excellent flavor; skin very thin; highly esteemed for table use during the winter and late fall.

PUMPKIN SWEET SUGAR (U. S. Dept. Agri.)—Strong growing vines; producing large fruit; when young is mottled over with grey spots; ribbed similar to the musk-melon; of fair quality.

Donations in 1894.

Received of Atlee, Burpee & Co., Philadelphia, 7 pkts. Pansy's, 8 pkts. Sweet Peas, 2 pkts. Mignonette, and one pkt. each of the following: Calliopsis, Dianthus, Coleus sunset strain, Fordhook Balsam, Renown pea, Echo pea, Fordhook squash, Bush Lima bean, Willow-leaf Lima bean, Early Black Lima bean, Early Black Pole bean, Burpee's Bush Lima bean, Burpee's New Stringless bean, New Giant White Cos lettuce, Iceberg lettuce, Wheeler's Tom Thumb lettuce, French Breakfast radish, New Improved French radish, Victoria Spinach, Matchless tomato, White Wonder cucumber, Sure Head cabbage, All Head Early cabbage, Early Fordhook Sweet corn, Burpee's Early Cauliflower, Fordhook Frost Tomato, Early Watermelon.

Received from H. F. French, Corvallis, 1 pkt. each of the following: Victoria onion, Giant White Cos lettuce, New Prizetaker onion.

Received from Northrup, Braslau, Goodwin & Co. 2 pkts. Pansy's, and one pkt. each of the following: Chrysanthemum, Kalamazoo celery, Imperial balsam, Imperial mixed balsam.

Received from J. Briggs, Albany, Linn Co., Or.: collection of Box trees, collection of Roses, 1 doz. Horse-chesnuts, ½ doz. Pyracantha, ½ doz, Cydonia Japonica, 4 doz. Laburnums, Collection of Gladiolus bulbs, Tulip bulbs and Hyacinth.

The following varieties of cions were received from the New York Experiment Station, Geneva N. Y.

APPLES.—Acuba-leaf, Alexander, Buckingham, Chenango Strawberry, Cooper's Market, Count Orloff, Fallawater, Golden Sweet, Grand Sultan, Hubbardston Nonesuch, Jeffries, Ohio, Peck's Pleasant, Pewaukee, Washington Royal, William's Favorite, York Imperial, Longfield, Pumpkin Sweet, Jersey Sweeting.

CRABS.—Blood Red, Chicago, Coral, Lady, Paul's Imperial, Pitca Striata Red Siberian.

CHERRIES.—Aburn Duke, Cleveland Bigarreau, Rostraver, Schmidt, Windsor, Downer late,.

PEARS.—Bordeaux, Bose, Boussock, Brandywine, Danas Hovey, Easter Beurre, Gans, Gifford, Hosenschenck, Late Bartlett, Lawson, Superfine.

PLUMS.—Burbank, Early Red, Field, Forest Garden, French Damson, Free Stone Damson, Sweet Damson, King of Damsons, Garfield, General Hand, Guii, Grand Duke, Lincoln, Ogon, Prince of Wales, Wild Goose, Wolf.

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Oregon Agricultural Experiment Station.

Bulletin No. 35. - March, 1895.



Agricultural Department.

I. FORAGE PLANTS.--(*a.*) *Clover.* (*b.*) *Vetches.*
(*c.*) *Flat Pea.* (*d.*) *Corn.*

II. PIG FEEDING.

The Bulletins of this Station are sent free to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE
H. R. CLARK, Manager.
CORVALLIS, OREGON:
1895.

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INTRODUCTION.

BY H. T. FRENCH.

As extensive wheat farming gives way to a more intensive system of farming, the attention of farmers will be turned toward better fodder plants, than those found on the farms throughout a large portion of the State.

Stock raising must go along with any system of intensive farming. The coarse products of the farm must be converted into meat and dairy products, and thus returning a large portion of the fertilizing elements to the soil.

At the present time considerable attention is being directed toward the dairy industry, as a source of revenue on the farm. And that a better knowledge of some of the common forage plants may be obtained, the following report is made.

It is an indisputable fact, that many dairy enterprises have met entire failure, because there has not been enough attention given to supplying the stock with suitable food during times of scarcity.

The natural pasture will supply an abundance of food during a portion of the year, although it is many times inferior to the artificial supply, or that which is raised by cultivation. As long as the dairy-men depend upon natural pasturage, they will not make the most of the opportunities that are so richly bestowed throughout a large portion of the state. It is only in the most favored localities that natural pasturage will pay. We hear the early settlers tell of the luxuriant vegetation which covered the hills and valleys during the pioneer days of the State, and some think it strange that the hills can not be induced to renew their verdure, and again be covered with a coat consisting of the native grasses and plants.

The native or wild grasses, which once covered the hills and valleys, have vanished never to appear again. They have gone out with the native red man never to occupy the land again. This fact is proven in the agricultural history of the older portions of this country, and in the countries of the old world. The crops

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all the plant food necessary for the crops and the farmer reaped abundant harvests. The time was in the East when it required as little care and thought to raise farm and fruit crops as is now given to such matters by the average farmer of this coast. The farmers in the Eastern States several years ago came to realize the immense robbery they had perpetrated upon their lands, and more recently the horticulturists of the same states have been brought face to face with this fact. An article recently appeared in the "Rural Northwest" from the pen of Prof. W. F. Massey, from which I quote:

"There is no doubt that the many failures in fruit production in the East are largely due to the exhaustion of important elements of plant food in the soil. All farmers realize the importance of keeping up the fertility of the soil for the production of their annual crops of grain and vegetables, but somehow the idea has been prevalent that a tree can take care of itself. Men look at the great trees of the forest and see how they grow and how the soil increases in fertility under their influence, and think that the same should be the result in the growing of fruit trees, while they are carrying off continually, not only the fruit that the orchard produces, but in many cases expect the land also to produce food for their stock And then when the orchard fails to give the expected fruit, and its decrepit condition makes the trees alike the prey to insects and fungus diseases, they declare that the climate has changed and we can no longer produce crops for that reason. It has really been because they and their fathers have robbed the soil until the needed food for the production of healthy trees and perfect fruit is no longer available."

Recognizing this condition of things it seems important that the farmers of this state should be made acquainted with some of the recognized facts concerning soils and fertilizers, and their relation to plant life and especially the conditions which obtain in our own state. This bulletin aims to give in a brief form some of the more important facts, and will be followed by others dealing with kindred subjects.

FOUNDATION LAWS OF MODERN AGRICULTURE.

(1) "A soil can be termed fertile only when it contains all the materials requisite for the nutrition of plants, in the required quantity, and in the proper form."

(2.) "With every crop, a portion of these ingredients is removed. A part of this portion is again added from the inexhaustible store of the atmosphere; another part, however, is lost forever, if not replaced."

(3.) The fertility of the soil remains unchanged, if all the ingredients of a crop are given back to the land. Such a restitution is affected by manure."

(4.) "The manure produced in the course of husbandry is not sufficient to maintain permanently the fertility of a farm; it lacks the constituents which are annually exported in the shape of grain, hay, milk and live stock."

It is the science of chemistry which has told us what we know of this subject, and it was not till these facts were determined that agriculture became a science. The improvements that have resulted since the foundation of these principles are marvelous.

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SOIL AND PLANT FOOD CONSTITUENTS.

In all nature there are now recognized about 70 elementary substances which are known as

ELEMENTS—*A chemical element is such a substance as cannot be separated into more than one kind of matter.* For example, iron, the smallest conceivable portion of which is just as truly iron as the largest mass.

These elements may be chemically combined in a great variety of ways to form an endless number of *compounds*, which may be defined as *substances consisting of two or more elements chemically combined in definite proportions.* The properties of these compounds differ from those of the elements of which they are composed, and from those of one another. These compounds are called *bases* or *acids* according as they possess certain characteristics.

Of the 70 elements only fourteen are considered essential to plant life. These are divided into two classes according as they do or do not form acids

Acid Forming Elements. (Non-meta'lic.)	*Base-Forming Elements.* (Metallic.)
Oxygen,	Calcium,
Hydrogen,	Potassium,
Carbon,	Sodium.
Nitrogen,	Iron,
Phosphorous,	Magnesium,
Sulfur*	Manganese.
Chlorin*	
Silicon.	

ACIDS.—Now if an *acid forming element* unites with oxygen and hydrogen, or sometimes with hydrogen alone, a substance is formed which is known in chemistry as an *acid*. Thus, nitrogen combined with hydrogen and oxygen forms nitric acid; phosphorous, hydrogen and oxygen from phosphoric acid.

BASES.—A *metallic* element combined with oxygen and hydrogen forms a *base*, known as a *hydrate* of that metal. Thus, calcium united with oxygen and hydrogen would be calcium hydrate. Sometimes the term base is applied to the compound of a metal and oxygen.

SALTS.—The two classes of compounds above mentioned are very active in a chemical sense, and having opposite properties they always tend to neutralize each other so that neither acids nor bases are found to any great extent free in nature, but rather in the form of compounds resulting from their combination, such compounds being called *salts*. It would be out of place for us to discuss here the relation existing between acids, bases, and salts further than to say that an acid differs from a salt only in having its hydrogen replaced by a metal, and that every acid has a salt corresponding to it. For example phosphoric acid consists of phosphorous, hydrogen and oxygen: now, if the hydrogen be replaced by calcium, the composition would be phosphorous, calcium, and oxygen, and the compound would be a calcium salt of phosphoric acid.

The subject of soil origin and composition was discussed at length in Bulletin No. 21, and therefore I shall only summarize here.

*This spelling is that which is now recognized by the American Chemical Society and is used in all chemical publications.

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First, the soil acts as a mechanical support for plauts. *Second*, the soil furnishes ash constituents to the plant. *Third*, the soil aids in developing the plant by modifying and storing the sun's heat, regulating the food supply and securing other important conditions.

THE OBJECT OF FERTILIZERS OR MANURES.

A rich soil contains an abundant supply of the elements above described and supplies all the necessary plant food. A virgin soil is usually rich, but as soon as the land is brought under cultivation the plant begins to draw from the soil and the materials are not all returned. Sooner or later the land becomes infertile and it is necessary to return a part of the ingredients which have been removed by the plants. Experience has shown that there are but three ingredients which need close attention, viz: phosphorus, potash and nitrogen. Therefore it is only these, together with calcium, oxygen, hydrogen and carbon which will be discussed at this time. The reason for including the four substances last mentioned is that the three critical ingredients may be the better understood.

In worn soils or such as do not give good returns (provided the soils be in good physical condition) it will usually be found that one or all of the first three ingredients mentioned are deficient, or if they are present they are not in an available (soluble) form. In all cases care should be taken to have the soil in a proper physical condition. Here in Oregon this matter is too often neglected; large quatities of wheat and other crops being allowed to drown in the water which should be removed by under-drainage.

To prevent the deterioration of soils is the aim of all modern agriculture. Soil exhaustion, however, is rather a relative term than an absolute one, and usually applies to a certain crop, since a change of crops developes latent soil resources, and upon this fact is based the principle of rotation. Any soil will maintain its fertility so long as the annual depletion is returned in an available form either naturally or artificially, the degree of fertility being dependent upon the minimum quantity of any essential plant food. "*The plant can make no substance out of nothing, or without a sufficient supply of each and every one of all the essential ingredients of its composition.*" *It is the object of manures and fertilizers to furnish to any soil a larger supply of the essential food ingredients.*

CLASSIFICATION OF FERTILIZERS.

- FERTILIZERS
  - INDIRECT
    - Lime
    - Gypsum
    - Salt
  - DIRECT
    - *Artificial*
      - Complete
      - Special
    - *Natural*
      - Stable Manure
      - Refuse Matter
      - Green Manures
      - Ashes
      - Muck, Marl, etc.

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EXPLANATION OF TERMS.

A *fertilizer*, in general terms, is any substance which added to the soil tends to produce a better growth of plants.

An *indirect fertilizer* is one, which, while it may not furnish to the soil plant food, so acts upon the matter already in the soil as to change more or less of it from an unavailable to an avaible form. A substance is said to be *available* when in a soluble form, although it is probable that no actual solution, in the common acceptance of the term, occurs.*

A *direct fertilizer* is one which is in such a condition that the roots of the plants can take it up readily, or the food material is *available*.

Artificial fertilizers are also called *chemical* or *commerical fertilizers*, and are prepared mixtures sold under trade names, the material of which they are composed being largely the waste products of many industries, and substances found in natural deposits.

Complete fertilizers are such as contain all three of the critical ingredients, nitrogen, potash, and phosphoric acid.

Special fertilizers contain only one or two of the above mentioned ingredients. They are also called *incomplete fertilizers*.

THE ELEMENTS AND THEIR RELATION TO FERTILIZERS.

OXYGEN.—Oxygen is by far the most abundant of all the elements. It forms about one-fifth of the atmosphere, where it exists in a free and uncombined state as a *gas*. It is the vital principle of the air we breathe. It constitutes about one-half of the solid crust of the earth, and eight-ninths of all the water. In these latter forms, it exists in a state of chemical combination with other elements. It combines chemically with nearly every known element, and is especially important in building up, and destroying all forms of organic matter. In a free state it is an invisible gas, posessing neither taste nor smell. It is called a supporter of combustion, because wood, and other burning substances, when plunged into it, will burn with increased brilliancy. Chemically considered it is a very active substance. In all forms of burning the oxygen of the air is combining with other elements, the heat being the result of the chemical union.

HYDROGEN is the element, which when chemically combined with oxygen, forms water. It constitutes about one-ninth, by weight, of all water, and enters into the composition of all plant and animals. It is the lightest substance known. Like oxygen, it is an invisible gas, without color, taste, or odor; but unlike oxygen, instead of being a supporter of combustion, it will, itself, burn when brought into contact with a flame. It is seldom, if ever, found in a free, or uncombined state.

HYDROGEN AND OXYGEN AS FERTILIZERS.—These two elements are supplied to plants in the form of water, which is the largest constituent of the growing plant. The plant tissue receives the necessary amount of each element by the separation of the water stored in the plant. There are several ways in which water is related to the fertility of the soil, but as directly related to fertilizers it bears no importont part, except that it should be

*Missouri Bulletin No. 19.

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present in as small an amount as possible. When irrigation is practiced the water may fulfill an important office as a fertilizer. Usually the water from rain furnishes all the oxygen and hydrogen that is needed, and much more.

I cannot refrain here from calling attention to the fact that too much water may be nearly, if not quite, as bad for a soil as too little, and this is particularly applicable to certain parts of Oregon. There are immense bodies, of so called "white land," which can be made excellent farming lands, equal to any, by ridding themof the superfluous amount of water by means of tile drainage. It is not only that the plant is likely to die from drowning, but the excess of water prevents the formation of available plant food, and also renders the physical condition of the soil unfit for supporting plant life. If the water does not flow off, it must evaporate at the surface, which tends to cool the soil. A proper system of drainage will not only remove the water, but keep the soil warm by preventing a too rapid surface evaporation; and when the ground is dry will allow a more perfect circulation of air and atmospheric moisture, thereby not only nourishing the plant, but also enabling the oxygen to act upon the latent plant food, rendering it available. This matter of tile drainage is a matter of paramount importance to farmers, and we recommend all to secure and read Bulletin No. 26 of this Station.

CARBON.—The element exists quite abundantly in a free state, and occurs under three forms (1) diamond, (2) graphite, (called black-lead,) (3) charcoal, lamp-black, coal, etc. It is the central element of all animal and vegetable material. There is not a thing endowed with life which does not contain this element. In plants it is combined with oxygen and hydrogen forming starch, sugar, wood fibre, etc. Most products of animal life contain these same elements, but united differently, as casein, fats, fibrin, etc. The element also occurs combined with oxygen alone in the form of a gas called carbon di-oxid, or often carbonic acid gas. Analysis shows that carbon constitutes about one-half of the solid portion of plants consequently it must be an important plant food. But extended experiments have shown that notwithstanding the element is so intimately associated with plants it may be left out of consideration in direct fertilizers for the carbon of the plant is taken from the carbon di-oxid of the atmosphere, which furnishes an inexhaustible supply.

NITROGEN.—This is a colorless, invisible gas without taste or color. It composes about four-fifths of the atmosphere. In addition to occuring in the atmosphere, it is found also in plants and animals. Animals cannot exist when left to breathe nitrogen alone, and yet it is not poisonous. Unlike oxygen and hydrogen, this gas will neither burn, nor will it support combustion. Nitrogen, when chemically combined with hydrogen, forms a gas known as *ammonia*, which is a very interesting compound to the farmer, because it constitutes a very important source of nitrogen as a plant food.

Ammonia exists in the atmosphere in small quantities, being formed when animal and vegetable matter containing nitrogen decomposes. With acids ammonia deports itself much like a metal in that it forms *salts*, which

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are called *ammonium salts.* Thus, ammonia combines with hydrochloric acid to form *ammonium chlorid*, or *muriate of ammonia*; with sulfuric acid it forms *ammonium sulfate.*

FORMS OF NITROGEN USEFUL TO PLANTS.

There are three forms of nitrogen which are useful to plants:—

(1) Atmospheric nitrogen: (2) nitrogen in ammonium salts: (3) nitrogen in nitrates. Each of these forms is found to be useful to certain kinds of plants. The number of plants that can utilize atmospheric nitrogen is not large. In general terms leguminous plants, such as peas, beans, clover, alfalfa, and the like, can use the uncombined nitrogen. Hence, such plants are frequently spoken of as "nitrogen gatherers." This is one of the reasons why such crops are often used as green manures.

Although some plants have the power to absorb nitrogen both directly and from ammonium salts through the medium of the soil, yet *by far the largest amount of nitrogen is derived from nitrates in the soil.* The nitrates are formed by a process known as *nitrification*, which is brought about by the oxidation of ammonia compounds and of organic matter in soil through the agency of microscopic organisms, bacteria, which exist every where in enormous numbers. The process is favored by warmth and moisture, no action taking place at a temperature below 40° F., nor in very dry soils, nor below 10 inches.

HUMUS A MEASURE OF NITROGEN.

Humus is a term applied to certain organic matter in soils. It expresses no definite product, but applies rather to the entire product of organic decomposition, or rather an intermediate stage of this decomposition. This process of organic decomposition results in the production of ammonia which combines with certain acids and is absorbed. Thus the humus may be taken as a measure of the nitrogen in a soil.

More or less ammonia escapes into the atmosphere from the organic matter decaying near the surface of the earth. This atmospheric ammonia is brought back to the earth by the rain and dew, which are seldom free from this compound, although the amount is small and variable. The experiments of Sir J. B. Lawes indicate that an average of about 5 lbs. of combined nitrogen per acre is brought to the soil annually by rain and dew, but in ordinary farm districts the supply of nitrogen from this source would probably not amount to a third of the combined nitrogen removed from soil by an average crop of wheat.

Under ordinary agricultural conditions the loss of nitrogen considerably exceeds that of natural supply and finally profitable crops cannot be grown without the use of nitrogenous manure.

REMOVAL OF NITROGEN.

The following table shows the average amount of nitrogen removed from the soil by one ton of several of the leading farm products. In the the same table, for the sake of reference, I have inserted the number of pounds of the other critical ingredients removed and also the value of th fertilizing material which would be required to replace this same matter.

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TABLE I.

Showing fertilizing material removed by one ton of some leading crops, and its market value.

NAME.	Potash. lbs.	Phosphoric acid lbs.	Nitrogen. lbs.	Value per ton.
Wheat kernels	11.4	18.8	36.8	$ 8.93
Wheat straw	12.4	5.0	11.0	3.13
Wheat chaff	2.8	3.8	22.0	4.38
Wheat bran	34.6	28.4	49.2	13.16
Oat kernels	9.8	15.2	38.0	8.90
Oat straw	20.2	5.0	16.6	3.88
Oat chaff	20.8	4.0	12.8	3.62
Timothy hay	25.4	15.2	23.6	6.88
Red clover	41.6	11.2	45.4	11.93
Alfalfa	42.2	13.4	49.4	12.87
Seradella	15.6	13.0	54.0	12.23
Corn stover	24.2	0 6	16.6	4.68
Corn kernels	7.4	11.8	33.0	6.75
Cabbage	34.2	15.0	4.8	3.59
Turnips	8.2	2.4	4.4	1.45
Potatoes	5.8	1.4	4.2	1.23
Linseed meal	23.2	28.4	49.2	24.30
Hops	4.0	3.5	50 6	10.52
Hop refuse	2.2	4.0	19.6	4.24
Grapes	10.0	3.0	3.4	1.38
Apples	1.6	0.06	1.2	.33
Pears	3 6	1.0	1.2	.49
Plums	3.4	8.0	8.4	1.91

In addition to the removal of nitrogen from the soil by plants it may be lost in soil water, provided it is combined in the form of nitrates, since soils have little power of fixing them in insoluble combinations. When the soil is covered with a green crop, however, there is little loss since plants absorb the nitrogen very rapidly. The practice of bare fallowing, then, is one which on this account alone is not to be recommended, and especially is this true in a climate which is very moist.

DIRECT NITROGENOUS FERTILIZER MATERIAL.

- NITROGENOUS FERTILIZERS
  - MINERAL
    - Sodium Nitrate
    - Ammonium Sulfate
    - Guano
  - ORGANIC
    - (Origin) *Animal*
      - Dried Blood
      - Meat Scraps
      - Tankage
      - Azotin
      - Dried Fish
      - Ground Fish
      - Wool Waste
      - Horn Dust
    - *Vegetable*
      - Cotton Seed Meal
      - Tobacco

SODIUM NITRATE (*Chili Saltpetre*) occurs in enormous deposits in Peru. The commercial salt contains about 16 per cent actual nitrogen. It is an excellent fertilizer, quick in action, but easily washed out of the soil, and therefore should be applied while the crop is growing, and in small quantities at a time.

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AMMONIUM SULFATE, is a waste or, bye-product, from the manufacture of illuminating gas. It contains about 20 per cent nitrogen and is much used in commercial fertilizers.

GUANOS containing nitrogen are now very limited, and practically out of the market.

ANIMAL MATTERS.—These are sufficiently described by their names, with perhaps the exception of tankage and azotin, the former of which is slaughter house refuse, and the latter a preparation of meat and membrane from which the fat has been extracted. All animal matter comes mainly from the slaughter house and fish oil factories. Some fertilizers contain horn, hair, and leather scraps, as a source of nitrogen, but this is not as valuable as most other forms of animal matter.

VEGETABLE MATTER.—But a limited amount of this is employed in fertilizers. The main form used is cotton seed meal, but this cuts a very limited figure in our markets.

POTASSIUM.

POTASSIUM.—This metallic element is never found free in nature, but is a constituent of many natural and artificial fertilizers. It is a soft metal, lighter than water, and possesses a great affinity for oxygen. Plants consume potash in relatively large amounts, yet in some soils the supply is nearly, if not quite, equal to the demand. The supply is mostly from the decomposition of feldspar which contains from 10 to16 per cent.

In the feldspars the potash is united with aluminum and silicon and is not immediately available as plant food, but under the combined action of air, water and frost the feldspars are so changed as to render the potash available. There is little loss of potash in drainage water, since soils are found to have the power of removing it from solutions and storing it in insoluble forms.

Plants vary much in the amount of potash they consume, and experiments show that where it is deficient the plants suffer greatly, the woody portion of plants, and the fleshy part of fruit, being dependent upon the influence of potash compounds.

As a fertilizer it is especially useful to the leafy crops as potatoes, beets, clover, etc., while grain is much less benefited.

POTASH FERTILIZING INGREDIENTS.

Patassium Chlorid	Potassium Sulfate
Kainite	Potassium Nitrate
Wood ashes	Cotton seed hull ashes

POTASSIUM CHLORID (*Muriate of Potash*:)—This furnishes the main supply of potash for most commercial fertilizers. It is obtained from the town of Strassfurt, in Northern Germany, where there is an inexhaustible supply of this and other grades of potash salts. Muriate contains about 50 per cent of actual potash, (K_2O,) from which it will be seen that it is a concentrated form, and really the cheapest per pound of potash, although a high priced product.

POTASSIUM SULFATE (*Sulfate of Potash*,) comes from the same source as the muriate and as found in the fertilizer market contains from 30 to 35

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per cent of actual potash. The price is higher than that of the muriate, but on certain crops it is found to act more favorably,

KAINITE.—This is the most common of the German potash salts, and is a mixture of several compounds, chiefly chlorids and sulfates of potash, sodium and magnesium. It is comparatively of low grade containg from 2 to 15 per cent of potash. It cannot be used with impunity since it contains sulfate of magnesia which is deleterious to some germinating seeds.

POTASSIUM NITRATE (*Saltpetre*,) is valuable not only for the potash, but also for the nitrogen it contains. Because of its high price it is very little used for a fertilizer.

WOOD ASHES.—For a cheap potash supply nothing is better than good unleached wood ashes, and it is practically the only American supply for potash. The amount of potash varies with the kind of wood, ranging from 7 to 14 per cent., with a small amount of phosphoric acid in addition. The potash is in the very soluble form of the carbonate. Leached ashes contain much less potash, often not more than 2 per cent. "Good wood ashes which have not been exposed to weather or otherwise wet * * * weigh about 48 lbs. to the bushel and carry about 8 per cent potash besides nearly 2 per cent phosphoric acid." They are worth at least 25 cents per bushel. Our orchardists could use nothing more beneficial for their small fruits and orchards. No farmer should waste the ashes produced on his farm.

PHOSPHOROUS.

PHOSPHOROUS.—In a chemically pure state phosphorous is a soft yellow, waxy solid, and extremely inflammable on account of its great affinity for oxygen. When it burns it simply unites with the oxygen of the air, the compound formed being commonly called *phosphoric acid* and it is this compound which is of such great value to the farmer.

The element never occurs free, but is combined with oxygen and lime. In this form it is known as phosphate of lime. It also occurs as phosphate of magnesia, and also of lime and alumina. These phosphates are only slightly soluble in water, so the quantity in the soil is only removed by the plants as it becomes available.

From a fertilizing standpoint the phosphates are second only to nitrogen in importance, and in particular cases may even exceed that element. The phosphates of fertilizers exist in three forms:—

1st, SOLUBLE PHOSPHATE.
2d., REVERTED "
3d., INSOLUBLE "

THE SOLUBLE FORM does not occur to any extent in nature. It is known under the names *acid phosphate of lime, and calcium superphosphate.* The phosphates of this form being soluble in water are of great great value as fertilizers. When a soluble phosphate is added to the soil it gradually changes to a form insoluble in water, which is probably the form known as REVERTED PHOSPHORIC ACID. This is not the ordinary form of insoluble phosphate, for while a reverted phosphate is quite

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insolule in water, it is readily soluble in dilute acids or solution of salts containing ammonia. The roots of plants contain a small amount of acid which renders them quite capable of using this form of phosphate, hence it is considered nearly as valuable as the soluble form. The *two taken together* constitute what is known as *available phosphoric acid.*

INSOLUBLE PHOSPHORIC ACID (*Calcium Phosphate,*) is so-called because it will not dissolve in water. It is the form in which phosphorous exists in most soils, bones, and rocks, and from which it is yielded to the plants with great difficulty. In this form the phosphates in fertilizers are of the least value to the puchaser. Insoluble phosphates may be converted into the soluble forms by treatment with sulfuric acid, which should be handled with extreme care.

Of the three forms the soluble contains the greatest amount of phosphorous; the reverted form the next greatest supply; and the insoluble form the least. As to the removal of phosphates from the soil, the insoluble form is, of course, not carried away by the soil water; the same is true of the reverted phosphates, but were it not for the fact that the soluble form is very quickly changed to the reverted condition it would doubtless be more or less removed by drainage water.

In general it can be said that soils become deficient in phosphoric acid quicker than in any other ingredient. In the case of basaltic soils there is often a very abundant supply of insoluble phosphates in the form of *apatite* crystals (calcium phosphate.)

BONES.—These are used extensively as a source of phosphoric acid. The usual form on the market is ground bone of various degrees of fineness—the finer the better. Bones are of a double value as they contain not only phosphoric acid, but also potash and nitrogen. They also occur in different conditions as stated below.

Raw Bones (of animals) consist of approximately:

Phosphate of lime	50.00
Carbonate of lime	25.00
Animal matter (containing Nitrogen, 4.00)	25.00
	100.00

Steamed Bones (animal bones which have been steamed to extract a part of the animal matter in the manufacture of glue, etc.) containing approximately:

Phosphate of lime	65.00
Carbonate of lime	20.00
Animal matter (containing nitrogen)	15.00
	100.00

Bone Black—known also as Animal Black and Animal Charcoal, made by heating bones in closed vessels—containing approximately:

Phosphate of lime	60.00
Carbonate of lime	10.00
Charcoal, etc	30.00
	100.00

Bone Ash (made by burning bones) containing approximately:

Phosphate of lime	75.00
Carbonate of lime, etc	25,00
	100.00

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Of late there has arisen quite a demand for bones for various industrial uses which has brought about a tendency in some instances to adulterate by the use of coal ashes, oyster shells, etc. Bones form valuable material and even those small amounts which occur about a farm should be husbanded by burying them in the orchard near trees where they will decay. Other ways of utilizing them are by burying them in an ash or manure heap and allowing them to become softened before putting them in the earth.

DISSOLVED BONE (*Bone Superphosphate*) is simply raw bone or bone ash which has been treated with sulfuric acid whereby the phosphoric acid is made more soluble. Fertilizers thus prepared are commercially known as "*superphosphates.*"

ROCK PHOSPHATE (*South Carolina Rock*) is used quite extensively in making superphosphates by treatment with sulfuric acid. Unless the rock has been so treated the phosphoric acid is mostly in the insoluble form.

BASIC OR THOMAS SLAG is now used to some extent. It is a waste product in the manufacture of iron. It is often sold under the name of '*Odorless phosphate.*" It usually contains about 50 per cent of phosphate of lime.

INDIRECT FERTILIZERS.—The most important substance under this head is *Lime in one or more of its forms.* It is the oxygen compound of calcium, *calcium oxid*, which is commonly known as lime. It is probably true that no other single substance has been so much used on land as lime, with the single exception of stable manure. Lime is made by burning limestone, and it is this burned or calcined form which shou d be used whenever it is deemed necessary. It has a three-fold action as a fertilizer:

First, as a direct source of plant food.

Second, rendering available inert plant food in the soil.

Third, improving the texture of the soil.

While a certain amount of lime is essential to the growth of plants yet experience has shown that as a direct fertilizer it does not fulfill all that might at first be expected, therefore it is classed as an indirect fertilizer. It is in the second action that lime produces the greatest chemical effect. It is a strong base, and therefore tends to neutralize any acidity of the soil, which occurs especially in wet boggy places, rendering the soil "sour." It facilitates nitrification and decomposing certain insoluble salts in the soil.

In many cases it can be used to advantage in improving the texture of soils. This is especially true of the heavy clays, which it tends to pulverize and lighten. Used on peaty or adobe soils, it will tend to decrease the organic matter by causing it to decompose more rapidly. It is in this office that lime could be used in many instances by the Oregon farmers in improving the clays of the Willamette Valley. Tile draining and lime, I am confident, would furnish to the State a large increase of available land. Care, however, should be taken to supply organic matter to such soils after liming or the last state will be worse than the first, for it is a trite and true saying that "Lime enriches the father but impoverishes the son."

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GYPSUM (*Calcium Sulfate.*)—This substance has been a bone of contention, and disputes have waxed warm and loud as to the cause of its beneficial action, for this it certainly possesses. It is largely used in some parts of the country to encourage the growth of clover. One writer speaks of the use of this substance, commonly called "gypsum," as follows: "There is reason to believe that gypsum causes the decomposition of certain compounds containing potash, whereby it, and some other bases, are made available for the use of crops—the lime taking the place of these in the compound decomposed—the sulfuric acid combining with them to form salts soluble in water. Admitting this to be the action, it tends to impoverish the soils to an extent far greater than is brought about by the use of most other manures."* It has been pretty conclusively proven that a portion, if not all of the above reaction take place in the case of *black* "alkali" soils, spots of which are not of unfrequent occurrence in certain parts of Eastern Oregon. The most profitable use of gypsum would doubtless be in such cases. In California it has been conclusively proven that it is a valuable remedy in such "spots," and when followed by active cultivation, will, in a large measure remedy this very undesirable condition. The use of gypsum together with underdrainage and irrigation if this be possible, and a proper selection of crops will cure in a comparatively short time the most of this hated *black* alkali.

Gypsum can also be used with profit to aid in obtaining a good "stand" of clover on the farms of the Willamette Valley to the cultivation of which crop farmers can profitably give their attention.

The great cost of gypsum at present will not permit its coming into general use, but there may be cases in which its use would doubly repay the expense. It is to be hoped that there are deposits in this State which will soon be opened, and for one who is fortunate enough to discover it in workable quantities, there is a rich harvest in store. It has been reported from Eastern Oregon—the very part of the State in which it could be used to great advantage—and samples of excellent quality have been sent to us for analysis, but so far we have not been able to verify "the find."

SALT, (*Sodium Chlorid.*)—Its application is likely to be useful in a limited number of cases, and with certain crops. It is usually best used in a compost. It has a very destructive action on vegetation if applied in excess, and should be used, if at all, with great care.

Fertilizing Material Produced on the Farm.

It is not our purpose to deal particularly with this topic at this time, but to issue a special bulletin on the subject later, yet there is one phase of the matter which I deem of so great importance that I take occasion to touch upon it now. I refer to the unnecessary waste of valuable material, which, with a little care and forethought, might serve as a valuable fertilizing material. While it is probably impossible to utilize *all* the straw produced on the farm without burning, yet it is equally true that every farmer could use much more than he does, and it should be the policy to use as much as possible. It is a wasteful process to burn, and still more suicidal

*Bulletin No. 19, Ark. Experiment Station.

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to sell it from the farm without returning anything to replace it. In burning the straw the valuable element nitrogen is dissipated in the air, while it would serve a valuable office in the soil. If the straw *must* be burned *it should be burned in very small piles instead of in large stacks*, as is so often the case, so that the ash material may not be fused and form *insoluble* silicates, but may furnish as much soluble plant food as possible.

Wheat and oat straw remove from the soil the following amounts of fertilizing material per acre, and the last column of the table gives the value of the straw from an acre of land upon this basis.

TABLE II.

RIND.	Potash in pounds.	Phosphoric acid in lbs.	Nitrogen in pounds.	Value.
Wheat straw.....	31.62	12.75	28.05	$7.29
Oat straw.....	22.22	5.50	13.86	$3.91

Therefore reckoned at the market price of nitrogen in the commercial forms it would cost to replace the nitrogen lost by burning the straw produced on one acre of ground $5.61, while it is a frequent occurrence to sell this same amount for not more than $2.00. Farmers of the east have paid for this by experience dearly bought, and the time is not far distant, when the farmer of this coast will realize its truth. Relative to this same matter I quote from Mo. Experiment Station Bulletin No. 19.

TABLE III.

Showing the value of plant food (phosphoric acid, potash and nitrogen) removed from one acre.

Wheat, kernels.....	$ 6.00	Timothy.....	$12.57
" straw.....	7.29		
	$13.24	Clover.....	$26.98
Oats, kernels	$ 3.81	Alfalfa.....	$23.17
" straw.....	3.62		
	$ 7.73	Potatoes.....	$ 7.07
Corn. kernels	$11.94	Carrots.....	$ 4.52
" cobs and husks.....	.96		
Stalks.....	$ 6.40	Cabbage...	$18.35
	$19.30		

"To take care, therefore, of straw and other vegetable refuse and return it to the land in a proper manner, is a matter of great importance; to sell timothy, clover, and alfalfa as such, rather than to feed it and sell it as flesh or milk, is bad policy and self-destruction. To value a crop simply by its market price, is crude and unscientific. The price which the farmer pays for it, is not only its cost of production, but in addition to it, its manurial value, which we have often neglected, and which the conditions of the case begin now to force upon us for serious consideration."

CONDITION OF OUR FERTILIZER MARKET.

While there is not a large consumption of fertilizers in this State, as compared with other states, yet the demand is on the increase and the business will always be an increasing one. The fact that there are large or-

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chards planted in our state is one reason why the fertilizer question will be brought forward soon, and will be a question of importance to the state. This is true because the wear to which the soil will be subjected is one-sided and will be continuous. At present there is no law of any force bearing on the sale of fertilizers in this state, and therefore there is no way the farmer may know what he is purchasing, except to rely on the honesty of the dealer. It is also true that there is no material which offers a greater opportunity for adulteration than these same fertilizers. While the Station has made analyses of most of the fertilizers offered for sale in the state yet *it cannot guarantee that the analysis printed in the table below represents each lot sold*, for the samples sent by manufacturers prove little or nothing, except for that individual sample, so that although the analyses are published under the name of the fertilizer, we cannot guarantee that another sample would give the same analysis or even approximating the same.

Still we have no reason to question the integrity of any dealer in this State. *Be it remembered, however, that the figures given in this bulletin are not in any sense to be taken as representing anything beyond the individual sample analysed.*

The *State should have enacted an adequate fertilizer law* in justice not only to the farmer, but to the manufacturers themselves, which would compel the manufacturers to make their standard, and thereafter hold to that standard. This is done in other states and should be done here.

At present the purchaser should be very careful to deal with reputable firms who are willing to *guarantee* a certain amount of fertilizing ingredients.

We publish below, without comment, a statement of the results of the analysis of certain fertilizers found in the Oregon market.

TABLE IV.

Showing analysis of fertilizers sold in Oregon.

Laboratory No.	NAME OF FERTILIZER.	Moisture.	PHOSPHORIC ACID.					Nitrogen.	Equivalent to Ammonia.	Potash.	Value per ton.
			Soluble.	Reverted.	Insoluble.	Total.	Available.				
431	Complete Fertilizer for light Soil	6 64	2.78	2 65	8.19	13.62	5.43	2.65	3.21	3.49	$29.80
432	Webfoot Hop Grower	8.67	2.15	8.23	2.94	13.32	10.38	2.06	2.50	4.07	33.34
433	Dried Blood	12.72						8.90	10.80		35.80
434	Muriate of Potash		.50				.50				55.00
435	Webfoot Potato Grower	6.03	4.90	3.11	8.11	16.16	8.05	3.25	3.98	2.33	34.10
436	Sodium Nitrate							8.08	10.68		35.80
437	Kainite		.19								20.80
438	Fruit and Vine Posphate	6.19	2.70	6.23	7.07	16.00	8.93	2.38	2.90	2.91	32.14
439	Vegetable Fertilizer	12.20	3.36	3.61	2.90	9.96	6.97	2.62	3.18	1.80	31.44
440	Fruit Fertilizer	15.79	5.60	5.14	4.10	14.84	10.74	2.34	2.84	2.19	32.48
441	Webfoot Potato Grower	7.11	2.55	3.73	1.21	7.49	6.28	2.20	2.67	4.65	25.32
442	Webfoot Orange Grower	8.05	2.84	2.82	3.61	9.27	5.66	2.46	2.99	6.40	28.66
443	Webfoot Complete Fertilizer	8.07	2.20	5.20	5.04	12.74	7.70	2.76	3 55	2.91	31.24
444	Complete Fertilizer for Light Soil	5.88	4.05	3.34	0.75	8.16	7.41	2.31	2.80	7.37	31.88
445	Webfoot Hop Grower	4.68	6.99	1.08	4.92	12.99	8.07	3.46	4 20	6.21	39.02
446	Webfoot Vine Grower	7.30	4.60	2.43	3.20	10.23	7.03	4.85	5.89	5.24	40.62
448	Mineral Fertilizer	.97	5.20	4.02	3.16	12.38	9.22	.65	.79	1.90	18.00
468	Fish Guano	9.91	2.41	1.00	2.60	6.01	3,41	5.49	6 65	3.32	32.96
466	Bone Meal Fertilizer	7.21	3.15	2.09	2 91	8.15	5.24	1.79	2.17		17.81
470	Odorless Phosphate	9.60	1.86	1.86	12.68	16.40	3.72				13.92
471	Grain Fertilizer	7.57	2.03	.84	3.63	6.50	2.87	1.84	2.23	2.34	17.99

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THE CHEMICAL VALUE OF A FERTILIZER.

Each of the three essential ingredients of a fertilizer has a commercial value, and the worth of any given ingredient may be stated in dollars and cents. These values are estimated from the essential ingredients in the fertilizer, and they express the *commercial value* based upon what the ingredient would cost in the open market The values do not pretend to express the agricultural value, which would of course be represented by the profit they would give the user, which would be a very variable quantity. The price upon which these values are based are as follows:

Available Phosphoric acid, per pound	8½ cents.
Insoluble " " " "	3 "
Potash from Muriate	5½ "
Potash from Sulfate	7 "
Nitrogen	20 "

The total cost of a ton of fertilizer (to the consumer) is made up of three elements: 1st the cost of material mixed; 2d. the cost of mixing; 3d. the cost of transportation, storage, etc., but the valuation takes into account only the first of these elements.

To figure the commercial value of a fertilizer, multiply the price of each ingredient by the number representing its per cent in the fertilizer, add together these results and the sum will represent the value in cents of the fertilizing material in 100 lbs. of fertilizer. Multiply the sum by 20 and the product will be the value in cents of one ton of the fertilizer.

Example:—A fertilizer was found to contain 7 per cent available phosphoric acid; 3 per cent nitrogen; and 4 per cent potash.

(1) Phosphoric acid	7x8½	59.5
(2) Nitrogen	3x20	60.0
(3) Potash	4x5½	22.0
(4) Value of 100 pounds		141.5

(5) Value of 2000 lbs, one ton, 141.5x20=2830 cents, or $28.30, to which should be added about $3.00 for bagging, etc.

In some cases there is a guaranteed amount of *ammonia* instead of nitrogen, in which case the number representing the ammonia should be multipled by the decimal, .8235 before applying the above calculation. Again, the amount of *potassium chlorid* (or *muriate*) may be guaranteed instead of actual potash. In such a case the amount of the chlorid should be first multiplied by .6318 to obtain the actual potash. To convert from the sulfate to actual potash it is necessary to multiply by .5404.

The Needs of Oregon Soils.

In the first place let it be remembered that the value of a *mere chemical analysis* of a soil is at most doubtful. An analysis of a soil reveals what and how much of a given ingredient is present in a soil but *it does not show* how much of the plant food is available. There is, however, more or less value attached to investigations of so-called "virgin soil," and an accumulated number of analyses on this class of soils gives very valuable data upon which to base a judgement of probable success or failure. This mat-

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ter has been more fully discussed in Bulletin No. 21, to which the reader is referred. In all cases chemical analysis should be followed by careful field tests, and in this way any one may become familiar with the individual needs of his soil. Experiments in the field have been very limited in this State, yet based upon the ordinary methods of judging deficiency of plant food in soils, chemical analysis of a large number of soils seems to indicate a limited amount of potash in the Willamette Valley soils, and this would doubtless be the first ingredient needed on the lowland, and the higher land seems to point toward a need of phosphoric acid. These results must however, be taken as only indicative, although these chemical results have been verified in instances where the experiment has been tried. The loams of Clackamas county have shown a good supply of potash, and a number of Lane county soils have shown a high content of phosphoric acid.

There is a common idea abroad that our soils are deficient in lime, yet the analysis of a large number of soils has not shown that to be true. The soils of the Willamette Valley possesses in nearly all instances a fair amount of lime and on passing into Eastern Oregon the lime content is nearly doubled. In general potash is to be the first element to be suspected as being deficient on the lowlands of the Willamette Valley and phosphoric acid on the uplands. It should also be said that the uplands are not in *all* cases well supplied with nitrogen, which is very essential to fruit production. The red hill lands possess a great power to absorb this element and ammonia and are naturally excellent fruit lands, yet when the fruit begins to shrink in size this element should be supplied. On the lower lands there is a greater supply of humus which is a very fair measure of nitrogen and when these soils are well drained they are likely to possess great capacity for production if potash is supplied. The conditions are so varied however, that, in order for any farmer or gardener to decide *positively* what kind of fertilizer will be best for him to use, it will be necessary for him to do some special experimenting. It is not best in all cases to select a complete fertilizer for often a portion of the material is not needed at all and the farmer may be "*carrying coal to Newcastle.*"

There is one thing that should be said relative to many of the valley lands, viz: that for lasting benefit in increased return and ease of handling careful attention would best be given to the physical condition by proper tile draining before turning attention to fertilizers, for in many instances the improvment of these conditions will be all that is necessary for some time to come.

Of the soils of Eastern Oregon but a limited number o analyses have been made, but acting upon experience in other states having similar climatic conditions and taking into account the origin of the soils of that part of the state we can say that the basaltic rocks would naturally produce a soil well supplied with phosphoric acid, and from this reason it will doubtless be found that when the soils fail it will be rather on the side of potash than phosphoric acid.

We trust that the matters discussed in these pages will prove of benefit to the farmer in not only paving the way for a better understanding of the

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principles of agricultural chemistry, but also in calling attention to some sources of waste in the economy of the farm. For reference we insert some tables which will prove of value to those who consult them with an earnest desire to understand the more modern practice of agriculture.

TABLE V.

Compiled Analyses of Commercial Fertilizing Material.

SUBSTANCE	Moisture	Nitrogen	Potash	Phosphoric Acid			Value per ton
				Available	Insoluble	Total	
Materials containing phosphates.							
Apatite						36.08	$14.43
Bone ash	7.00					35.89	14.35
Bone black	4.60					28.28	11.31
Bone black (dissolved)				16.70	0.30	17.00	21.84
Bone meal	7.47	4.12		8.28	15.22	23.50	40.56
Bone meal (dissolved)		2.60		13.53	4.07	17.60	30.27
Peruvian guano	14.81	7.85	2.61	8.36	6.90	15.26	39.21
S. Carolina rock, ground	1.50			0.60	27.43	28.03	11.69
S. " " dissolved				11.60	3.60	15.20	16.52
Basic Slag						21.37	8.55
Material containing potassium.							
Carnallite			13.68				12.31
Kainite	3.20		13.54				29.92
Muriate of potash	2.00		52.46				47.20
Nitrate of potash	1.93	13.09	45.19				81.25
Spent tan bark ashes	6.31		2.04			1.61	3.85
Sulfate of potash	1.25		38.60				42.46
Wood ashes, unleached	12.00		5.50			1.85	7.90
" " leached			1.10			1.40	2.61
Material containing nitrogen.							
Azotin	5.88	11.33				3.43	43.09
Cotton seed meal	6.80	6.66	1.62			1.45	25.20
Dried blood	12.50	10.52				1.91	38.73
Dried fish	12.75	7.25	0.45	3.05	5.20	8.25	34.12
Horn and hoof waste	10.17	13.25				1.83	20.38
Meat scrap	12.09	10.44				2.07	38.61
Nitrate of soda		16.47					51.05
Sulfate of ammonia	1.00	20.50					69.70
Tankage	13.20	6.82		5.02	6.23	11.25	31.71
Wool waste	9.27	5.64	1.30			0.29	9.62

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Oregon Agricultural Experiment Station.

Bulletin No. 37. - - May, 1895.

AGRICULTURE.



Experiments in Cattle Feeding.

The Bulletins of this Station are sent free to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE
H. R. CLARK, Manager.
CORVALLIS, OREGON:
1895.

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CATTLE FEEDING.

BY H. T. FRENCH.

The subject of stall feeding cattle is quite a new one in the live stock industry of this state, and especially in the Willamette valley. Where so little corn is grown, and where such luxuriant pastures prevailed as did at one time exist in this valley, and are found even now in favored locations, it is not strange that little attention was given to this matter. But the conditions have changed in the past few years. Grain no longer pays a large profit when sold in the measure, and the natural pastures are less productive than they once were. Low prices for beef cattle, and little discrimination on the part of the buyer between good and poor beef, have had a marked influence in keeping people from stall feeding cattle. Another very fertile cause is found in the vast ranges of public domain which supported stock in large numbers at little expense. These almost limitless public pastures do not now exist hence there will be a growing demand for a more intensive system of feeding stock. May it not be safely predicted that cattle are entering upon an era of greater demand and consequently better prices? Every thing seems to point in this direction.

It was with a view of throwing some light upon the subject of cattle feeding that the following experiments were undertaken. The results are not wholly satisfactory, yet they will suggest some valuable points perhaps, and serve as a guide to future work along this line.

The objects of the experiment were: first, to test the value of grain and coarse products which can be grown upon the farms of a large portion of Oregon; second, to show if possible that it

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is not profitable to sell animals only partially prepared for the market, and at a time when the market is over run with stock from the range.

It has been our observation during the past six years that cattle are very low in the fall and early winter, consequently this is not the time to sell, if we can keep the animals two or three months longer and not loose money by the operation.

With these two objects in view six grade Polled Angus cattle were purchased, five steers and a spayed heifer. Four of the steers were used in the experimental feeding here recorded.

The cattle were very wild when purchased, and it required a month or six weeks to get them accustomed to their surroundings. They were put with the herd the first of October, and driven to the barn every night for a month before any attempt was made to place them in stalls. No grain was fed during this time. November first the animals were secured by a chain tie about the neck. This is called the German tie. The chain is secured by a rod which passes through a ring at the end of the chain, and is bolted to the side of the stall. By this means the animal is securely tied and yet has more freedom than the stanchion gives.

The animals were kept here for a few days, and water and food carried to them three times a day. They were then released during the day and again tied at night. This was continued until the feeding experiments began December 6th, when the animals were kept up all the time and only led out to be weighed every two weeks.

The feed was weighed out to them three times daily and water was given to them in the stall.

I have written this in detail to show how much care must be taken if the animals are induced to take on flesh rapidly. The first, last and all the time object, must be to make the animals contented and quiet. Before a month had past nearly every animal would eat from the hand of the one who fed them.

Would it not have been better to have given the cattle more exercise? This question is often asked, and we will say that there is more danger of such cattle taking too much exercise, if given an opportunity, than there is of not getting enough. If properly fed and watered there is no injury from keeping them

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in close quarters. The animals were about two years and nine months old when the feeding began.

In the case of the first two, Tommy and Tobe, the feeding began Dec. 6th. These two were fed chopped wheat for a grain ration, and clover hay and corn silage for coarse feed. The grain was divided into three feeds, and fed with clover hay in the morning, with silage at noon and, with clover hay at evening. The grain was mixed with the coarse feed. Much stress was placed upon feeding the animals regularly. The benefits of this are well understood and need no further discussion.

The first two steers, Tommy and Tobe, were fed chopped wheat alone, except during the last two weeks they were given a little oil meal. On the whole, I do not think that chopped wheat is as good a ration as a mixture of wheat, oats, and bran.

The second two steers were fed a mixture of equal parts by weight, of these grains, and the results are a little more satisfactory. The animals appeared to relish their feed better. It is quite as important to know what is *not* a profitable grain ration as to know the best, hence the results of feeding wheat alone are not without some value.

The feeding of the second two steers was not begun until a month later than the first two, owing to the fact that they were not fully reconciled to their quarters. The coarse feed consisted of clover hay, cut with a feed cutter, corn silage and vetch hay. The vetch hay was fed only to Silas one of the steers in lot 2. This was substituted in the place of the clover, for the purpose of comparing the two substances for feeding purposes. The vetch hay was made from the winter variety cut during July, and carefully cured the same as clover hay. This part of the experiment will be interesting to many who are now experimenting in raising this plant, Our experiments do not prove it to be superior to clover; but it is eaten very readily and gives satifactory results. It is certainly worthy of a place among the hay crops for Western Oregon. The corn silage was a very good sample, made from yellow dent corn just past the roasting stage. The corn was grown on summer fallow. It was stored in the silo the first of October.

This method has an important bearing upon the feeding of

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stock. If the summer fallows of Oregon could be made to produce a crop, and thereby pay for the cultivation which they ought to receive, it would be a very economical method of producing food for stock. Not only is it better for the half starved cattle, but it will assist in increasing the production of grain as well. The constant cultivation which the corn needs, together with the shading of the ground, has a very beneficial effect upon the fertility of the soil.

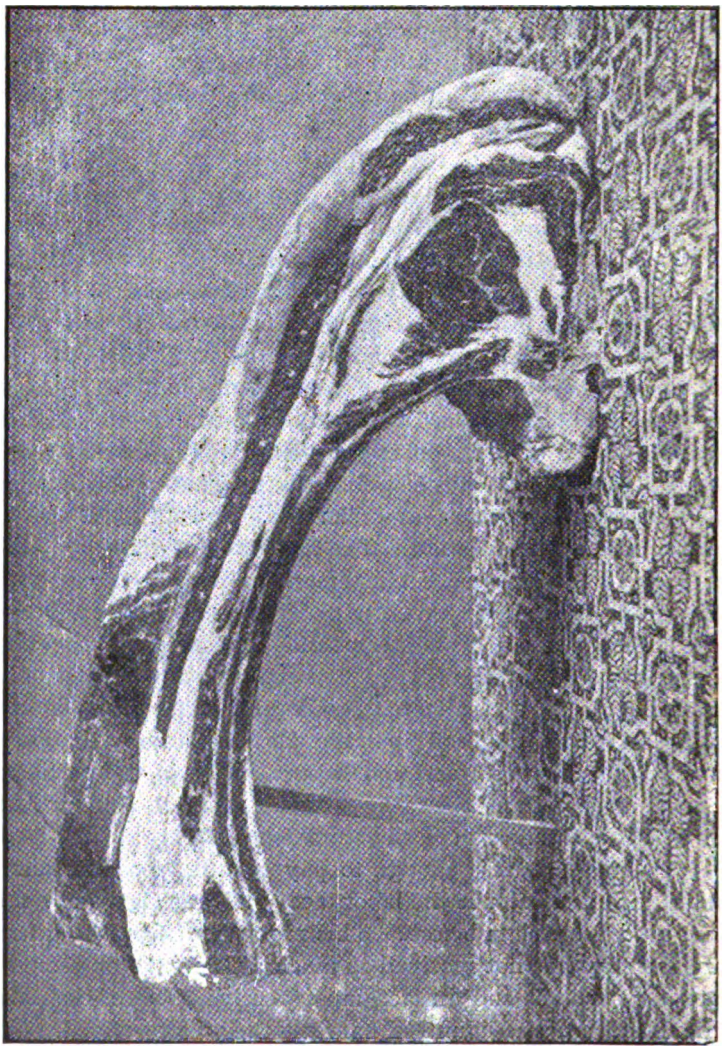
RESULTS.

By consulting the table in the summary it will be seen that the steers, Tommy and Tobe, ate 2308½ pounds of chopped wheat which at $13.00 per ton amounts to $15.00. They also consumed 1737 pounds of hay valued at $5.00 per ton or $4.34; corn silage, 4076 lbs. at $1.50 per ton, cost of raising and placing in the silo or $3. 00; 100 pounds of roots at 25 cents per cwt.; and 19 pounds of oil meal at 1¼ cents per pound. This makes the total cost of feed from December 6th to March 28th, $22.83. Total gain, live weight, during this time was 435 pounds or an average cost per pound of gain of 5.25 cents. This at first thought would preclude any chance for profit, but there is another side to the question. The steers cost $30.00 or 1¾ cents per pound. If we charge the steers up with first cost $30.00, plus $22.83 for feed, we have $52.83. The steers were sold to a local butcher for 2¾ cents per pound live weight, or $58.57. This leaves a net profit of $5.74, not counting the labor which is fully balanced by the value of the manure. The matter of keeping the fertilizing material upon the farm is a very important consideration. In feeding animals very little of the fertilizing elements are lost from the farm; for only a small amount is required in the production of the animal product.

If there is realized enough to pay for the food consumed, the manure will balance the labor account, and leave the farm more productive than before. This problem of furnishing farmyard manure has not received as much attention throughout our state, as it should, and in fact, must receive, before the farms will again bring the bountiful harvests they once yielded.

There is another consideration which is an important one, and that is, the stock raiser sells his stock in the fall at a sacrifice, because the food supply on his farm will not warrant stall feeding. The price of beef has been so low, there has not been

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much inducement, but beef will invariably sell for 1½ to 2 cents per pound more in the spring than in the fall, hence, if the animals will pay for their feed, which they will, with beef at 3½ cents per pound, counting the profits which arise from the increased price per pound for the original weight of the cattle.

In the experiments with the steers fed on the mixture of grain the results are a little more favorable. These steers were fed on equal parts by weight of chopped wheat, oats and bran. Vetch hay was fed from January 3d. to February 14th to Silas and clover was fed the remainder of the period, and the vetch was fed to Beecher in place of the clover hay. Corn silage was fed to both the whole time. Other conditions were the same as in the first two animals. Silas consumed 1158 lbs. of grain, worth $5. 57; 710 lbs. of hay, worth $1.77; 1596 lbs. of corn silage, worth $1.12, and 9½ lbs. of oil meal worth 12 cents. Total cost of food $8. 58.

Gain in live weight, 180 lbs. at 2¾ cents, $4.95. Add to this the increased value of the original weight one cent per pound, or $9.65 gives $14.60. Subtract the value of food consumed leaves $6.02 profit over cost price and expense. Average gain per day was 2.22 lbs.

Beecher consumed 888½ lbs. of grain costing $5.17, 480 lbs. hay, worth $1.20, 1886 lbs. silage worth $1.41, and oil meal 12 cents. Total cost of food $6.90.

Gain in live weight 195 lbs. at 2¾ cents per pound $5.36 add the increased value of the original weight at one cent per pound $9.40 gives $14.76. Subtract the value of food consumed leaves $7.86 net profit. Gain per day 2.40 lbs.

There was no perceptible difference in the results between feeding the vetch and clover, except in the fact that the second steer Beecher did not relish the vetch as well as Silas.

The animals were sold to a local butcher who weighed the carcasses carefully, showing a dressed weight of 59 per cent. While this is not high it speaks well for the breed and shows that the animals were fairly well matured.

The beef was nicely marbled and of excellent color.

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CONCLUSIONS.

1. While the results are not wholly satisfactory, they will assist in determining the line of future work.

2. The gains per day will compare favorably with those made by feeding corn meal.

3. That animals can be well matured at three years of age by feeding such grains as wheat, oats, and bran.

4, That it is not economy to sell steers in the fall at a reduced price, even at the present low price for stall fed beef.

5. With a reasonable price for stall fed beef, the results indicate that there may be as good returns realized here as in localities where corn is used as a principle grain food.

It is the intention of the Agricultural department to continue these experiments, believing that the matter of stall feeding is a very important one, both in its relations to the dairy, and in the production of beef.

The cut of beef shown on page 82, is one taken from a Polled Angus heifer sold off the farm at three years of age, and whose gross weight was 1637 pounds.

Mr. C. D. Thompson, farm foreman, had charge of the feeding.

SUMMARY.

	Tommy.	Tobe.	Silas.	Beecher.
	lbs.	lbs.	lbs.	lbs.
Weight December 6.....	840 Dec. 6	855 Jan. 3	965 Jan. 3	940
" March 28.....	1070	1060	1145	1135
Total gain.....	230	205	180	195
Total grain.....	1150¼	1158¼	959	888½
Total hay.....	855½	881¾	710	480
Silage.....	2036	2040	1596	1886
Roots.....		100		
Oil meal.....	9½	9½	9½	9½
Average daily gain.....	2.11	1.88	2.22	2.40
Grain per pound of gain	5.00	5.64	5.33	4.56

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Oregon Agricultural

EXPERIMENT STATION.

Bulletin No. 38. - September, 1895.

DEPARTMENT OF ENTOMOLOGY.

FRUIT PESTS.

1. *Report on Fungicides and Insecticides.*
2. *Fruit Pests and Remedies.*
3. *Entomological Calendar..*
4. *Beneficial Insects.*

F. L. WASHBURN.

The Bulletins of this Station are sent free to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE.
H. R. CLARK, Printer.
CORVALLIS, OREGON:
1895.

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A STUDY IN THE ECONOMY OF CATTLE FOODS.

BY G. W. SHAW.

The subject of stock feeding is an important one to this State, and is destined to be more so in the near future. It is important not only to the producer of cattle for the butcher's block, but also to every farmer who has to do with stock of any kind, for it improves the chance of supplementing the articles at hand in an economical manner and to suit the varied conditions and desires. This is the more so in these times of close margins, when every business has to be reduced to the strictest economy. It is "penny wise and pound foolish" for us to pursue in these days the methods of twenty-five years ago, when there was scarcely anything known either of the composition or digestibility of cattle foods. If we would succeed in any business it behooves us to spend a portion of our time in reading the experience of others, and of the investigations that are being conducted along the lines in which our business interests lie. It is no more essential that the manufacturer should be abreast of the times in order to succeed, than that the farmer should be acquainted with the latest discoveries in his business.

There is today a veritable struggle for existence, and this becomes more intense year by year in all pursuits. Farming, once regarded as the simplest of all occupations, has become one of the most complex. The farmer who follows practices of years ago, when he had but to sow the seed and harvest the crop, to pitch out the hay to his cattle, letting them eat as much as they would and trample under foot any that remained, has little remuneration to-day for his toil. The new methods that have taken the place of the old hap-hazard ways always require considerable thought, and often very close study. As the result of this, the farmer must become a student as well as a thorough business man. As time advances it becomes more and more evident that "No department of natural science is incapable of yielding instruction to the tiller of the soil." We can no longer look with

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suspicion upon anything that smacks of science, for knowledge which comes to us through its channels has been obtained by the most careful observations and experiment.

The ultimate purpose of all agricultural investigation is how to produce more plants and animals upon the same area at a less expense. With reference to this question during the last ten years a great many important problems have been solved, and none has a more important bearing upon farm economy than that of rational stock feeding. We must admit that much still remains to be done in this field, yet the results so far obtained have put an entirely different aspect upon this branch of farm operations. The field is a vast one, and we might almost say that it is boundless; and the varied local conditions so modify the circumstances that there is need of special investigation in each locality. The solution of these problems demands long and carefully conducted experiments, for the questions that have to be met are not only the composition of the fodder articles, but also their relative digestibility under the existing circumstances and with the particular kind of animal in hand, and how much of the various nutrients each kind of animal needs to support life, and to do the desired work.

In the state of Oregon on January 1, 1893 there were the following animals.

Horses	294,509,	Valued at	$13,479,667
Mules	4,755,	" "	249,503
Milch Cows	107,183,	" "	2,572,392
Oxen and other Cattle	781,114,	" "	12,238,890
Sheep	2,456,077,	" "	5,903,182
Hogs	204,609,	" "	912,760

A saving of but ten cents per month would aggregate over four and one-half million dollars to the state per year, and such a saving by rational feeding alone would be a very conservative estimate. Then there are the wasteful methods of handling manure, which will demand attention at another time.

A writer has tersely put the question of farm management as requiring a knowledge of "1. What fodder crops to grow; 2. which will produce the most nutritive matter per acre at the lowest cost; 3. how to feed these in such a way as to get the benefit of all they contain; and 4. how to return to the soil as

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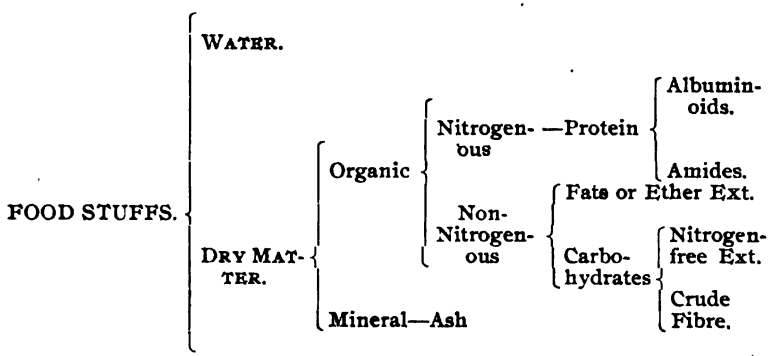
much as possible of the manurial matter removed with the crop."

It is the province of this bulletin to set forth the results of the analyses of some of the grasses commonly grown in this state, as well as some explanation of the methods used in calculating rations. It is the legitimate office of any bulletin to disseminate among the farmers of the state in which it is published, results that will be useful to them, wherever those results may have been obtained, of course giving proper credit for the source. Hence in this publication is given a table showing the average composition of many common feeding stuffs. It is deemed best to give this at this time since of late there has been considerable inquiry for such information. The results given in Table III. represent averages of a large number of analyses made in many places in this country.

As this is essentially the first bulletin issued from this Station bearing directly on this important question, it will not be out of place to explain some of the terms which are used in all discussions of a like nature. These it will be necessary to understand in order to intelligently comprehend not only this bulletin, but also the farm literature as it appears in the best agricultural papers.

COMPOSITION OF CATTLE-FOODS.

The following description is put in as simple terms as possible without sacrificing accuracy of statement, and in no sense pretends to be new matter. The composition of food-stuffs, whether plant or animal, may be graphically represented as follows:



It will be noticed that in all cases water is present. In

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many instances this is very evident, as in grass, beets, turnips, etc.; while in other material it is not so evident, yet when they seem perfectly dry under ordinary conditions, there is from 5 to 10 per cent moisture present. This water has no more food value than that taken from wells or streams. It is, however, a necessary constituent of the animal body, of which it composes from 40 to 50 per cent. Moisture is determined in the laboratory by heating the material for a long time at the temperature of boiling water, and in feeding stuffs, for technical reasons, this is conducted in a current of dry hydrogen. After the moisture has been driven off there is left the *dry matter*, which is partly organic and partly mineral in its composition. The mineral matter of plants has already been discussed in a previous bulletin, No. 36. In fodder analyses this mineral part of the plant is expressed by the term *ash*. It is the residue left after burning to perfect whiteness.

The organic matter embraces two well marked classes, viz., those containing the element nitrogen, *nitrogenous;* and those which lack nitrogen, *non-nitrogenous*. Of all the material composing a food-stuff, the nitrogenous matter is the most important. It embraces both albuminoids and amides, which, however, are not usually separated, but classed together as *Crude Protein*. The albuminoids compose much the larger part, and are the more important. They contain about 16 per cent of nitrogen, and are determined by an estimation of this element in the food-stuff. The part which these bodies play in the animal economy is the very important one of producing or renewing flesh (muscle or lean meat.) Their office is two-fold for they also furnish material from which the animal is able to elaborate a certain amount of fat. Yet by feeding the animal protein alone he cannot be kept alive for any length of time. Experiment has conclusively demonstrated that only by feeding all three ingredients can this be done without sacrificing health or flesh. The relative amount of protein, and its digestibility, determines in a large measure the commercial value of a food-stuff

Nearly all food-stuffs contain more or less fat. This term is not used here in as definite a sense as in ordinary language, but rather refers to a class of bodies which have a similar com-

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position, and since they are determined by extraction with ether, many chemists prefer to use the name *Ether Extract*. It really denotes more than fat, including in the case of grasses, clovers and other green food-stuffs, the coloring matter and certain gums. But in grain the extract is nearly all fats and oils. These do not differ in any essential particular from the animal fats and oils, which all belong to a class of bodies known as glycerides. As intimated above an animal has power to form fats in its own body, hence does not rely solely on the supply from the food-stuff. The function of this class of bodies is to keep up the animal heat. It seems to make no difference as to the source of the fat, for even in the butter from milch cows that had been fed on cotton-seed meal, thereby affecting the milk, Babcock failed to find any trace of the foreign fat, and pronounced it all butter fat.* As a heat producer the value of the fat of a food-stuff is 2½ times that of the other carbohydrates.

The CARBOHYDRATES are usually separated into *Crude Fibre*, and another class called *Nitrogen-free Extract*. The former is the woody tissue of the plant, which remains after successive boilings with a weak acid and a weak alkali. Carefully conducted experiments show that even this woody fibre has a nutritive value, a small quantity usually being digested. Still the value of food-stuffs usually varies inversely as the amount of crude fibre present. The *Nitrogen-free Extract* is composed of a number of substances, as starch, sugar, dextrin, and gums, grouped together because similar in composition. The entire group of carbohydrates is used to keep up the vital heat of the body, and produce fat to be stored up in the animal tissues for reserve fuel.

So far as known all changes of whatever kind occur in nature in accordance with fixed methods. "Like causes produce like results." This is as true in the process of animal digestion as elsewhere. The processes of nutrition are carried on according to well fixed laws, and it has been one of the objects of scientific research to arrive at a better understanding of these laws in order that they may be applied in feeding animals. The history of investigations to ascertain just what is the correct

*6th Annual Report of N. Y. Exp. Station.

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proportions of nutrients to feed animals to produce different results, and that the most economically, covers a period of about thirty years, the earliest experiments being made by Bischoff and Voit, in Munich, Slohmann and Hennebey, in Weende, and Wolff, in Hohenheim. The results of these investigations, and later ones in America, have resulted in such intelligent tabulations as to enable us to get better results and more profit than with the old hap-hazard, guess-work method.

That a food-stuff may be of the greatest value, it must have a certain proportion existing between the nutrients, and these must be accompanied by a certain amount of non-nutritive matter. All the material of a food-stuff is not digestible. The per cent of digestible matter, then, is not the actual amount of nutritive matter present as shown in the analysis of the fodder. But a chemical analysis is the first step to render the results of feeding experiments intelligible, and is absolutely essential to an understanding of the material we are using in rations. *It is the foundation upon which the whole question of rational system of feeding rests. By chemical analysis it has been possible to determine not only the amount of nutritive matter in a great many fodders but also what percent of each class of nutrients is digestible.* So it is possible to measure the nutritive value of most of the common food-stuffs.

Before animals could be fed intelligently it was necessary to know their demands for the production of certain results. For instance, what was the proportion of nutrients demanded by an ox to simply maintain life and health, and what did he demand when at hard labor, and what should be the proportion to produce the quickest returns when he was intended for the block? This was a difficult question to solve, but the Germans, with their accustomed persistency, went at the problem, and as a result have been able to formulate a table of feeding standards, which gives the needs of various animals under different conditions. The ones obtained by Prof. Emil Wolff are the ones which are almost universally adopted by both German and American feeders. These results represent the average of a large number of experiments, as do the other tables here given.

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TABLE I. FEEDING STANDARDS.

Pounds per Day per 1,000 Pounds Live Weight.

	Total Organic Matter.	Fat.	Protein.	Nitrogen-Free Extract.	Total Nutritive Substance.	Nutritive Ratio.
Horse at light work	21.0	0.40	1 5	9.5	11.40	1:7.0
Horse at average work	22.5	0.60	1.8	11.2	13.60	1:7.0
Horse at hard work	25.5	0.80	2.8	13.4	17.0	1:5.5
Oxen at rest in stall	17.5	0.15	0.7	8.0	8.85	1:12.
Oxen at ordinary work	24.0	0.30	1.6	11.3	13.2	1:7.5
Oxen at hard work	26.0	0.50	2.4	13.2	16.10	1:6.0
Oxen fattening—first period	27.0	0.50	2.5	15.0	18.0	1:6.5
Oxen fattening—second period	26.0	0.70	3.0	14.8	18.5	1:5.5
Oxen fattening—third period	25 0	0.60	2.7	14 8	18.1	1:6.0
Milch Cows	24.0	0.40	2.5	12.5	15.4	1:5.4
Sheep—wool producing (coarse breed)	20.0	0.20	1.2	10.3	11.7	1:9.0
Sheep—wool producing (fine breed)	22.5	0.25	1.5	11.4	13.15	1:8.0
Sheep—fattening, first period	26.0	0.50	3.0	15.2	18.7	1:5.5
Sheep—fattening, second period	25.0	0.60	3.5	14.4	18.5	1:4.5
Swine—fattening, first period	36.0	.....	5.9	27.5	32.5	1:5.5
Swine—fattening, second period	31.0	.....	4.9	24.0	28.9	1:6.0
Swine—fattening, third period	23.5	.....	2.7	17.5	20.2	1:6.5

In place of the standard as above given for milch cows, Dr. Babcock* suggests the one given below as better adapted to this country:

Total organic matter	25.0 lbs.
Digestible protein	2.2 "
Digestible carbohydrates	13.1 "
Digestible fat	.7 "
Total digestible matter	16.0 "
Nutritive Ratio	1:6.8

NUTRITIVE RATIO AND FUEL VALUE.

It is found that under different conditions animals demand different ratios of the flesh-forming nutrients (protein) to the heat-producing nutrients (carbohydrates.) For instance, if the carbohydrates are disproportionately increased and the proteins correspondingly decreased the result will be a loss of flesh and strength. Since this is true it can readily be seen that it is a matter of importance for any feeder to understand thoroughly the feeding material with which he has to deal. He should understand not only its composition, but also its digestibility.

The ratio existing between the protein and the carbohydrates is known as the "*Nutritive Ratio*", and is an extremely important index to the quality of the food, as found by actual di-

*9th Annual Report of Wisconsin Exp. Station.

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gestion experiments. The term shows not only the relative amount of food constituents in the material, but also indicates on what side the food should be supplemented to produce the desired results at the least cost. To illustrate how the nutritive value, or nutritive ratio, is determined, let us take a chance illustration.

There is in Red Top hay

Digestible Protein	4.13	per cent.
Digestible Nitrogen-free Extract	30.35	"
Digestible Fibre	17.28	"
Digestible Fat	72 × 2½ = 1.80	"

4.13) 49.43

11.9 or 1:11.9

which expresses the nutritive ratio. The fat is multiplied by 2½ since experiments shows that pound for pound it supplies 2½ times as much heat as the carbohydrates. Provided there is much protein matter the ratio is said to be close; and wide when there is a small amount of protein as compared with the carbohydrates. If we examine the table of feeding standards on page 37 we shall see that in the case of fattening cattle, we have a much closer ration in the second period than in either the first or third periods.

The heat producing power of foods is also an important element. This is expressed in terms of "Potential Energy," the unit of which is the *calorie of heat*, or the amount of heat required to raise one pound of water 4 degrees Fahrenheit. The heat giving power is best expressed in *calories per pound of food consumed*. Calculated in this manner the following general estimate may be made of the average potential energy in one pound of food nutrients.

	Calories per pound.
Protein	1860
Fat, or Ether Extract	4220
Carbo hydrates	1860

It is doubtless true that these figures are not absolutely correct, but they represent the best of modern research, and are certainly within a very small limit of error.

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DIGESTIBILITY OF FOOD-STUFFS.

The chemical analysis of a fodder does not represent its food value. A part of the food eaten by an animal is indigestible. The relative amount of digestible and indigestible matter varies with different food-stuffs and the higher or lower degree of digestibility very materially affects its nutritive value. Different stages of growth also influence the digestibility of the food-stuff, and therefore its food value. The amount of digestible matter for most of the common cattle-foods has been determined by feeding animals for a stated period upon food whose composition has been previously determined by analysis. The material so used is weighed, and the excreta of the animal very carefully collected, weighed and analyzed. The excreta is supposed to closely represent the indigestible matter, and from its analysis and that of the food eaten can be calculated the amount digested. The per cents of the various nutrients that can be digested by an animal are called the *Digestion Co-efficients.*

The amount of digestible matter, then, can be computed, when we know the digestion co-efficients, as follows: Suppose we know the composition of alfalfa to be as follows:

Protein	5.91	×	78	= 4.61	Digestible
Fat	1.15	×	42	= 0.48	"
Nitrogen-free Extract	12.02	×	70	= 8.41	"
Crude Fibre	10.57	×	42	= 4.44	"

The digestion co-efficients of a number of the common food-stuffs, as determined by various experimenters, is given in table II below, that the figures may be accessible to the farmers of this state. The figures will be subject to change as more extended experiments are conducted in this country. Such figures, on account of the time required for digestion experiments are not subject to rapid change, and they will serve as a fair index of the digestibility for some time.

The chemical department of the Station is now at work determining the composition of Oregon grasses, forage plants, grains and mill products and will issue bulletins relative to each as often as it seems best to do so. These analyses will be followed as far as possible, by digestion experiments with animals in order to further demonstrate the value of the various foods. In the present bulletin we wish to set forth the composition of a few Oregon grasses as determined in the laboratory of the Station. The writer is well aware that the results show a condition of things contrary to the popular idea in some portions

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of the state. Yet this is just the reasons for publishing the results. The results are in harmony, however, with the recognized facts as found in other states.

TABLE II.

Showing the Digestion Co-efficients, as determined by American Experimenters.

FEEDING STUFFS.	Trials.	Organic Matter.	Protein.	Fat.	Nitrogen-Free Extract.	Fibre.
Grass, Rye, etc., green	6	.....	74	67	73	83
Corn Fodder, green	3	.....	74	69	73	74
Clover, Alfalfa, etc., green	2	.....	67	64	78	53
Corn Silage	18	.....	46	80	67	67
Sorghum	...	62	62	85	78	60
Hay of Grasses	47	.....	54	54	63	55
Corn Fodder, dry	37	.....	58	71	69	70
Corn Stalks	4	.....	52	52	64	66
Mixed Hay, clover and timothy	3	.....	42	54	57	49
Clover, Alfalfa, etc., hay	14	51	61	49	65	46
Oat Straw	2	.....	40	37	52	57
Cow-pea hay	2	.....	65	50	71	43
Vetch hay	...	.....	76	60	66	54
Wheat Straw	...	.....	17	36	39	56
Rye Straw	...	.....	23	32	37	58
Potatoes	...	.....	69	...	96	55
Roots	8	.....	84	...	95	80
Milling and other material.						
Wheat Shorts	...	.....	78	68	68†	...
Corn Meal	2	.....	76*	82	92	87
Pea Meal	2	.....	83	54	94	26
Wheat Bran and Middlings	6	68	78	76	72	33*
Linseed Meal	...	.....	86	90	80	35
Cotton Seed Meal	2	.....	89	100	68	33*
Oats	...	.....	82	80	75	23
Gluten Meal	1	89	87	88	91	...

*European Experiment. †Includes fibre.

The materials which we propose to discuss are red clover, timothy, orchard grass, tall oat grass, cheat, and oat straw. The value of the articles given below is not intended to express more than the *relative* value. The actual value is governed by too varying circumstances to be expressed in any definite figures. The figures do tell us this, that if we pay $12.87 per ton for clover hay, we should be able to secure timothy at $11.73. If we pay less than the amount named above for the clover the proportion existing between the prices should be as 12.87 is to 11.73. In reckoning these values we have counted the digestible fat and protein as worth 4 1-3 cents per pound, and the digestible carbohydrates at 9-10 of a cent per pound.

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A FEW OREGON FODDER PLANTS.

RED CLOVER. *Trifolium pratense*, L.

The sample was cut when in full bloom in the summer of 1894, and hung in the laboratory till the spring of 1895, when it was analyzed. The composition was as follows:

	Percentage Composition	Calculated to Dry Substance.	Digestible Matter in 100 lbs.
Water	9.39	- -	- -
Dry Matter	90.61	- -	- -
Ash	7.71	8.58	- -
Protein	8.26	9.11	5.04
Crude Fibre	28.45	31.40	13.09
Nitrogin-free Extract	43.76	48.29	28.44
Ether Extract	2.43	2.69	1.19

Nutritive ratio 1:8. 8. Heat units in 1 pound 916.42. Relative value $12.87 per ton.

This excellent forage plant is so well known that a description here would be superfluous, however, a few words as to its production may not be out of place. There is no doubt but that the farmers of the Willamette valley could profitably pay more attention to the production of clover. There are three reasons for this statement, first, that clover is king of all forage plants; second, owing to its power to gather nitrogen from the air, it is a great enricher of the soil, and therefore would tend to preserve the soil fertility; third, the conditions, as shown by careful trials, are in many cases favorable to its production. As the question of soil fertility is forced upon the attention of the farmers, as it is bound to in the not far distant future, the merits of clover will become better known, and we shall see it taking a regular place in farm crops. As to its adaptibility to the Willamette valley, and the method of seeding to secure a good stand, we refer the reader to Bulletin No. 35, by Prof. H. T. French, of this Station. There are many soils in this valley adapted to its production, and at the Station success has attended its seeding even on the "white lands." There is a popular belief that the soils of the Willamette valley are deficient in lime and therefore unsuited to the growing of clover. But analysis does not show this to be the case, in fact the soils in nearly all cases carry a fair amount of lime—on an average about 0.4 per cent—while

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east of the mountains this amount is nearly doubled. There is certainly a sufficient supply of lime to meet the demands of clover, which, while it is said to do the best on a calcareous soil, will do well even if the lime content is comparatively small.

TIMOTHY. *Phleum pratense*, L.

This is an average sample, and was gathered when in early bloom.

	Percentage Composition	Calculated to Dry Matter	Digestible Matter in 100 lbs.
Water	11.19	- -	- -
Dry Matter	88.81	- -	- -
Ash	3.98	4.48	- -
Protein	6.02	6.77	3.25
Crude Fibre	30.35	34.15	16.69
Nitrogen-free Extract	46.25	52.13	29.14
Ether Extract	2.20	2.47	1.19

Nutritive Ratio 1:14.8. Heat units in 1 pound 963.11. Relative value $11.42 per ton.

The grass is a perenial, and adapted to moist heavy soils, but since it roots shallowly it is quite easily affected by drouth. While popular judgement places this grass at the head of the list, yet a large number of chemical analyses and digestion experiments fail to support this idea. Timothy is successfully grown throughout the valleys of the state, and in some localities grows as high as 7 to 8 feet. While this grass sells better than most other grasses, yet for feeding purposes it is not equal to some others, as will be seen by comparing the figures above given with the following.

ORCHARD GRASS *Dactylis glomerata*, L.

The sample was cut while in bloom. Its composition was as follows:

	Percentage Composition	Calculated to Dry Matter	Digestible Matter in 100 lbs.
Water	11.80	- -	- -
Dry Matter	88.20	- -	- -
Ash	5.90	6.60	- -
Protein	8.17	9.26	4.41
Crude Fibre	38.33	43.46	21.08
Nitrogen-free Extract	33.54	38.12	21.13
Ether Extract	2.26	2.56	1.22

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Nutritive Ratio 1:7.2. Heat units in 1 pound 918.81. Relative value $11.73 per ton.

This grass has been tried on the Station farm and of it Prof. French says:

"There is no state in the Union where orchard grass does better than in Oregon. It makes good pasturage, and when cut early it can not be easily excelled for hay. It does well on the level lands of the Willamette valley, and on the red hill land it grows with great vigor. In most parts of Oregon it is desirable to get a grass which will mature early so that it can make its growth before the dry season begins. This grass meets these requirements completely. It begins to head in April, and is often ready to cut in May. It continues its growth through the winter, furnishing a good growth for pasturage. If sown alone it should be sown thick; but the best results are obtained when sown with clover or some other grass. In spring this grass will furnish a bite two weeks earlier than most other grasses. When grazed down it soon recovers its vigor of growth."

In England the grass is considered better than timothy, and many feeders in this country who have tried it side by side with other grasses give it the preference. Of it Mr. I. A. Cole says: "After twenty years experience I have settled down on orchard grass as posessing greater merits than any other for both the pasture and meadow for fattening animals or for the dairy stock. When cut for hay just before its bloom, and cured with as little sun as possible, it will make more milk than any other variety known to me."

Its superiority is also borne out by chemical analyses. To obtain the greatest food value the grass should be cut while in early bloom.

TALL OAT GRASS *Arrhenatherum avenaceum*, Beauv.

Composition of Air Dry Substance	Calculated to Dry Matter	Digestible Matter in 100 lbs.
Water.....14.30	- -	- -
Dry Matter.....85.70	- -	- -
Ash..... 7.23	8.43	- -
Protein.....10.88	12.69	13.14
Crude Fibre.....24.36	28.42	26.97
Nitrogen-free Extract...42.82	52.34	26.97
Ether Extract..... 2.41	2.80	1.20

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Nutritive ratio 1:7.2. Heat units in 1 pound 912.56. Relative value $12.39 per ton.

The trials made with this grass in Oregon have met with marked success. It is a deep feeder, and consequently will withstand very dry weather and produce an excellent crop. An examination of its analysis as stated above will show it to have a high feeding value, indeed to have the highest of any of the grasses here treated. It is best used together with some clover as the cattle eat it more readily when thus mixed.

CHEAT, OR CHESS. *Bromus secalinus*, L.

	Composition Air Dry Substance	Calculated to Dry Matter	Digestible Matter in 100lbs
Water	8.56	- -	- -
Dry Matter	91.44	- -	- -
Ash	9.19	10.05	- -
Protein	3.61	3.94	1.95
Crude Fibre	31.90	33.79	17.55
Nitrogen-free Extract	44.99	50.30	28.44
Ether Extract	1.75	1.92	.95

Nutritive ratio 1:24.5. Heat units in 1 pounds 941.77. Relative value $10.79 per ton.

In some portions of the state this grass is grown considerably. For hay it does not compare with any of the grasses named above. The samples used for analysis were of average quality, and while if cut a little earlier they would have made a little better showing, yet experience elsewhere conclusively has shown that this is a poor grass so far as food value is concerned. Our farmers would do better to use either tall oat grass or orchard grass. Foods are pretty fairly measured by the amount of protein they contain. In cheat we find this constituent low. The fact of its low feeding value is so well established that it is rarely used elsewhere as an agricultural grass. Our analysis simply adds strength to other analyses, and the sooner the farmers of certain portions of the state recognize the limited value of the grass the better. To more fully test the grass in this state the writer, in connection with the agriculturist of the Station, will shortly enter upon a feeding experiment with the hay of

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cheat. But the results given in the above table may be taken as fairly representing its relative value.

The reasons for it being a poor grass may be set forth as follows. As stated above, experiments show that animals require a certain amount of each nutrient for the maintainance of life, health and strength. Of these ingredients protein is the most important, and of this cheat contains a relatively small amount. Hence in order to obtain the requisite amount of flesh-forming matter (protein,) the animal has to eat an excessive amount of other ingredients, which is a waste, and tends to injure the digestive system of the animal. To use cheat alone would be much the same as to attempt to feed a person altogether on potatoes. A correct ratio with this hay should contain a more liberal supply of nitrogenous grains than most other hays. It will be noted that cheat contains but little more protein, or flesh-forming material, than the sample of oat straw analyzed, which was an excellent sample. Less cheat and more clover would, indeed, be a boon to the state.

There is also another reason why cheat is considered inferior. It is an annual, necessitating the preparation of ground and seeding each year which is no small expense. This of course increases very materially the cost of the crop over that of either oat or orchard grass which are perennials. In calculating the feeding value of course this has not been taken into account, but in counting the actual agricultural value of the grass this would form a very important item, and make this grass still less valuable. In fact cheat comes much nearer to oat straw in value than it does to either of the other grasses mentioned.

Oat Straw.

The sample of oat straw may be considered a good one, as the grain was not over-ripe when cut, and therefore shows a little closer nutritive ratio than is usual.

Composition Air Dry Substance		Calculated to Dry Matter	Digestible Matter in 100 lbs
Water	9.62	- -	- -
Dry Matter	90.38	- -	- -
Ash	5.20	5.62	- -
Protein	3.51	3.78	1.40
Crude Fibre	43.37	46.94	24.82
Nitrogen-free Extract	36.02	41.63	18.73
Ether Extract	2.21	2.39	.44

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Nutritive ratio 1:27.8. Heat units in 1 pound 853.62. Relative value $9.43 per ton.

By comparing the analysis of straw with the other as here given it will be seen that it is deficient in feeding qualities, particularly in albuminoids and fats, yet by a proper balancing by means of succulent foods, as roots or silage, and materials rich in albuminoids and fats, as oil meal, a considerable amount of straw can be fed to animals at a profit, especially if the animals are properly housed. Oil meal can now be had as cheaply on this coast as it can in the east, and indeed it is even cheaper than quoted in Chicago. It is an extremely valuable food to be fed in connection with the coarser foods, and it is safe to say that if it does not cost more than $25 per ton it can in most cases be used with profit. At present it is quoted at a much lower figure than this. A too large proportion of straw should not be used as it will tend to constipate the animal, but with a proper balancing the succulent food and roots will furnish the necessary laxative matter to counterbalance the above tendency, and the straw will serve as an excellent source of income on the farm. The ill repute which it has obtained comes largely from trying to economize by feeding it without combining the proper amount of protein and fats.

We have not spoken of the manurial value of any of these substances, which of itself is an important item. While it is not our intention to speak at length of this side of the matter at this time, it may be said that an animal averages to take out of a fodder about 20 per cent of its value, the balance being contained in the excreta which in all instances should be saved and returned to the land. There is not as much attention paid to this saving as there ought to be, but in the not far distant future its necessity will be forced upon us. In the calculation of the quality of any food-stuff for farm use, the manurial value should also receive attention and be added to the food value, thus giving the total value of the fodder to the farm.

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CALCULATING RATIONS FROM THE TABLES.

While it is not our purpose to dwell at length on the question of cattle rations, yet it is desirable to introduce the subject in this bulletin in order to explain the use of the tables, and to pave the way for future publications treating of feeding experiments.

Having discussed the various terms applied to fodder analysis, we can come directly to the use of the tables. In the computation of rations it is evident that only the digestible part of a food need be considered. An examination of Table II, page 39, will show that some fodders may be considered as *concentrated*, while others are *coarse*. Among the concentrated foods we would place such substances as wheat, oats, oil meal, pea meal, etc.; while the latter class would include the hays, grasses, and many waste products. In the compounding of rations we attempt to make such a combination of the two classes as will give the best results. Let us illustrate, suppose we have on hand red clover hay, oat hay, cut in the milk stage, wheat bran, and coarsely ground wheat, and that we are desirous of compounding a suitable ration for milch cows, the average weight of which is 1000 pounds. Find in Table I, or rather the American standard below the table, the *nutritive ratio* required under the circumstances, and also the amount of the various nutrients. There we find that the nutritive ratio should be about 1: 6. 8, that the animal should have about 25 pounds of dry matter composed as follows:

Protein	2.20
Carbohydrates	13.10
Fat	.70
Total Nutritive Matter	16.00

In making up the ration the tables should not be followed too rigidly for no two lots of food material will have exactly the same composition. They do, however, represent a very close approximation to the true composition of the substances given. After a careful examination of the table, suppose we decide to form a *trial ration* of 10 pounds clover hay, 15 pounds oat hay, and 5 pounds wheat bran. In Table II, page 3, we find that in 100 pounds clover hay there are 6.74 pounds digestible matter, or .0674 in one pound. In 10 pounds then, there

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would be .0674 × 10, or .674 as in the table below. In like manner the other nutrients are calculated.

	Protein.	Carbohydrates.	Fat.
10.lbs. Clover hay	0.67	3.76	0.16
15 lbs. Oat hay	0.75	6.61	0.20
5 lbs. Wheat bran	0.57	2.19	0.12
Total Digestible Nutrients	1.99	12.56	0.48

Comparing these nutrients with the standard they will all be found too low. To remedy this let us use 15 pounds clover and 10 pounds oat hay. Calculating in the same manner as above, the ration will stand as follows:

15 lbs. Clover hay	1.01	5.64	0.24
10 lbs. Oat hay	.50	4.45	0.13
5 lbs. Wheat bran	.57	2.19	0.12
Total Digestible Nutrients	2.08.	12.28	0.49

Still the nutrients are too low. For a third trial let us use 11 pounds of Oat hay, and add 1 pound of the ground wheat, which will give the following ration:

15 lbs. Clover hay	1.01	5.64	0.24
11 lbs. Oat hay	.55	4.89	0.14
5 lbs. Wheat bran	.57	2.19	0.12
1 lb. Wheat	.10	.71	0.02
Total Digestive Nutrients	2.23	13.43	0.52.

Calculating the nutritive ratio as before explained we shall find it to be 1: 6. 6 which is close to our standard. The fat is lower than the standard, but the carbohydrates are higher, and will to some extent compensate for the lack of fat since the two classes have the same office in animal economy. While a small departure from the standard is allowable, a broad one should always be avoided. If these tables are even approximately followed there will be a decided saving in the feeding of animals. The tables are in no wise speculative, but are the result of laborious and painstaking experiment conducted by many trained specialists, and so far as experience has gone there is no reason to doubt their accuracy. They are not, however, inflexible rules, but rather guides, to be followed as good sense and judgement may direct, bearing in mind that a wide deviation will always be at the expense of the desired results.

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TABLE III.—*Average Composition of American Feeding Stuffs.*

Feeding Stuffs.	No. of analyses.	Percentage Composition. Water.	Ash.	Crude protein.	Crude fibre.	Nitrogen-free Extract.	Ether extract.	Organic matter.	Per cent Digestible Matter. Crude protein.	Carbo hydrates	Ether extract.	Nutritive Ratio.
Green fodders and silage.												
Pasture grass	.....	80.0	2.0	3.	4.0	9.7	.8	18.0	2.6	10.6	.5	4.5
Green fodder corn (maize)	126	79.3	1.2	1.8	5.0	12.2	.5	19.5	1.3	11.8	.4	9.8
Alfalfa (lucern)	23	71.8	2.7	4.8	7.4	12.3	1.0	25.5	3.6	11.4	.4	3.4
Green clover	43	70.8	2.1	4.4	8.1	13.5	1.1	27.1	2.9	14.1	.7	5.4
Alsike clover, in bloom	4	74.8	2.0	3.9	7.4	11.0	.9	23.2	2.7	13.1	.6	5.4
Rye fodder	7	76.6	1.8	2.6	11.6	6.8	.6	21.6	2.1	14.1	.4	7.2
Oat fodder	5	65.2	2.5	3.4	11.2	19.3	1.4	35.3	2.7	22.7	1.0	9.3
Red top, in bloom	5	64.8	2.3	3.3	9.4	19.1	1.2	32.9	2.3	20.5	.7	9.6
Meadow fescue, in bloom	4	69.9	1.8	2.4	10.8	14.3	.8	28.3	1.7	17.8	.5	11.2
Timothy	56	61.6	2.1	3.1	11.8	20.2	1.2	36.3	2.2	23.0	.7	11.1
Blue grass	18	65.1	2.8	4.1	9.1	17.6	1.3	32.1	2.9	19.2	.8	7.3
Corn silage	99	79.1	1.4	1.7	6.0	11.1	.8	19.5	.8	11.6	.7	16.6
Clover silage	5	72.0	2.6	4.2	8.4	11.6	1.2	25.4	2.0	13.2	1.0	8.0
Hay and dry coarse fodders.												
Fodder corn (maize), field cured	35	42.2	2.7	4.5	4.3	34.7	1.6	55.1	2.6	33.3	1.1	13.8
Hay from red clover	38	15.3	6.2	12.3	24.8	38.1	3.3	78.5	6.5	34.6	1.6	5.9
Hay from mammoth clover	10	21.2	6.1	10.7	24.5	33.6	3.9	72.7	5.7	32.6	1.9	6.4
Hay from alfalfa (lucern)	21	8.4	7.4	14.3	25.0	42.7	2.2	84.2	7.6	37.8	1.3	5.4
Hay from alsike clover	9	9.7	8.3	12.8	25.6	40.7	2.9	82.0	6.8	36.8	1.4	5.8
Oat hay, cut in milk	.....	9.2	6.5	8.9	28.1	44.7	2.7	84.3	5.0	44.0	1.3	9.4
Timothy hay	68	13.	4.4	5.9	29.0	45.0	2.5	82.4	3.0	43.9	1.2	15.6
Hay from mixed meadow grasses	11	16.0	4.6	6.4	29.9	41.0	2.1	79.4	3.6	42.7	1.0	12.5
Marsh hay	2	7.9	5.2	7.8	30.1	46.3	2.7	86.9	3.5	44.7	1.7	13.9
Oat straw	12	9.2	5.1	4.0	37.0	42.4	2.3	85.7	1.9	41.4	.7	27.1
Barley straw	97	14.2	5.7	3.5	36.0	36.0	1.5	80.1	.9	41.3	.6	47.5
Wheat straw	7	9.6	4.2	3.4	38.1	43.4	1.3	86.2	.8	37.9	.5	48.9
Rye straw	7	7.1	3.2	3.0	38.9	46.6	1.2	89.7	.8	42.7	.4	54.1
Buckwheat straw	3	9.9	5.5	5.2	43.0	35.1	1.3	84.6	2.3	37.7	.6	17.0
Pea vine	14	13.6	6.6	9.0	35.5	33.7	1.6	79.8	4.3	32.3	.8	7.9
Roots and Tubers.												
Potatoes	12	78.9	1.0	2.1	.6	17.3	.1	20.1	1.4	16.1	.1	11.6
Red beets	9	88.5	1.0	1.5	.9	8.0	.1	10.5	.9	7.6	.1	8.7
Sugar beets	19	86.5	.9	1.8	.9	9.8	.1	12.6	1.1	9.3	.1	8.6
Mangel wurzels	9	90.9	1.1	1.4	.9	5.5	.2	8.0	1.1	4.8	.2	4.8
Rutabagas	4	88.6	1.2	1.2	1.3	7.5	.2	10.2	.9	7.1	.2	8.4
Turnips	3	90.5	.8	1.1	1.2	6.2	.2	8.7	.6	5.5	.2	10.0
Carrots	8	88.6	1.0	1.1	1.3	7.6	.4	10.4	1.0	7.1	.3	7.8
Grains and Mill Products.												
Corn (maize)	208	10.9	1.5	10.5	2.1	69.6	5.4	87.6	7.1	62.7	4.2	10.3
Corn and cob meal	7	15.1	1.5	8.5	6.6	64.8	3.5	83.4	6.5	56.3	2.9	9.7
Oats	30	11.0	3.0	11.8	9.5	59.7	5.0	86.0	9.1	44.7	4.1	6.0
Oat shorts	6	10.0	5.2	16.2	7.5	54.5	6.6	84.8	12.6	45.7	5.4	4.6
Barley	10	10.9	2.4	12.4	2.7	69.8	1.8	86.7	9.5	66.1	1.2	7.2
Wheat	310	10.5	1.8	11.9	1.8	71.9	2.1	87.7	9.2	64.9	1.4	7.4
Wheat bran—roller process	7	12.0	5.6	16.1	8.4	53.7	4.2	82.4	12.6	44.1	2.9	4.0
Wheat bran—old process	9	12.0	4.9	13.0	8.1	58.2	3.8	83.1	10.1	47.5	2.6	5.3
Wheat shorts	12	11.8	4.6	14.9	7.4	56.8	4.5	83.6	11.6	45.4	3.2	4.6
Wheat middlings	33	12.1	3.4	15.7	4.7	60.2	4.0	84.5	12.2	47.2	2.9	4.4
Rye	9	11.6	1.9	10.6	1.7	72.5	1.7	86.5	8.3	65.5	1.2	8.2
Rye bran	7	11.6	3.6	14.7	3.5	63.8	2.8	84.8	9.7	48.0	1.6	5.4
Rye shorts	1	9.3	4.9	18.0	5.1	59.9	2.8	85.8	11.9	45.1	1.6	4.1
Buckwheat	8	12.6	2.0	10.0	7.	64.5	2.2	85.4	7.7	49.2	1.8	6.9
Buckwheat bran	2	10.5	3.0	12.4	31.9	38.8	3.3	86.5	7.4	30.4	1.6	4.7
Buckwheat shorts	2	11.1	5.1	27.1	8.3	40.8	7.6	83.8	21.1	33.5	5.5	2.2
Buckwheat middlings	6	12.7	5.1	28.2	4.2	42.3	7.5	82.2	22.0	33.4	5.4	2.0
Pea meal	2	10.5	2.6	20.2	14.4	51.1	1.2	86.9	18.0	56.0	.6	3.1
Cow pea	5	14.8	3.2	20.8	4.1	55.7	1.4	82.0	18.3	54.2	1.1	3.1
Miscellaneous Feeds.												
Linseed meal, old process	2	9.2	5.7	32.9	8.9	35.4	7.9	85.1	28.3	32.8	7.1	1.1
Linseed meal, new process	14	10.1	5.8	32.2	9.5	38.5	3.0	84.1	27.2	32.9	2.7	1.0
Apples	36	84.8	.5	.4	1.5	12.5	.3	14.7	.3	12.8	.2	44.3
Apple pomace	7	76.7	.5	1.4	3.9	16.2	1.3	22.8	1.0	11.9	1.1	14.6
Skimmed milk	96	90.4	.7	3.3	.....	4.7	.8	8.9	9.3	4.7	.8	2.1
Buttermilk	85	90.1	.7	4.0	.....	4.0	1.1	9.2	3.1	4.0	1.1	1.7
Whey	46	93.4	.7	.9	.....	4.8	.3	5.9	.8	4.7	.3	6.9

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RESUME.

In the State of Oregon on January 1, 1893, there were the following animals: horses, 204,509; mules, 4,755; milch cows, 107,183; oxen and other cattle, 781,114; sheep, 2,456,077; hogs, 504,609. A saving of but ten cents per month per head in the method of feeding would amount to over four and one-half million dollars annually. The question of rational feeding, then, is an important one, and demands the attention of every farmer.

It is the province of this bulletin to discuss this subject from the chemical standpoint, as well as to present analyses of some Oregon fodder plants.

The analysis of a food-stuff is expressed in the following terms: water, dry matter, ash, protein, ether extract, crude fibre, and nitrogen-free extract. The water has no more food value than that obtained from streams. The dry matter is what remains after all the water has been driven off. The ash is the mineral matter which remains after the organic matter has been burned away. The term protein is applied to the class of bodies containing nitrogen, which element composes about 16 per cent o the protein. The office of these nitrogenous bodies is that of flesh forming. The ether extract includes fats, oils, certain gums, and coloring matters. Crude fibre is the woody tissue of the plant or grain. The nitrogen free-extract embraces all other bodies than those named, among which are sugar, starch, dextrin and certain gums. The ether extract, crude fibre, and nitrogen-free extract together are called carbohydrates, the office of which is to furnish vital heat and produce fat, for which pur-

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pose the ether extract has 2½ times the value of the other carbohydrates.

All the material of a food-stuff is not digestible. To be of the greatest value there must be a certain ratio existing between the nutrients, and there must be a certain amount of non-nutritive matter. These conditions vary according to what is desired from the animal.

By chemical analysis, which is the foundation of rational feeding, it has been possible to determine not only the composition of the various food-stuffs, but also the digestibility of each nutrient, and what proportions of nutrients are needed by various classes of animals to produce desired results. (See Tables I, II, and III.)

The index to the quality of food is its "nutritive ratio," or the ratio existing between the digestible protein and the digestible carbohydrates.

The percents of the nutrients that can be digested are known as digestion co-efficients. Knowing these and the analysis of any fodder, it is possible to ascertain approximately the amount digestible. The digestion co-efficients for many materials have been determined, (See Table II) and also the composition of many food-stuffs. (Table III.)

Analysis and computation of the relative digestible matter in red clover, tall oat grass, orchard grass, timothy, cheat, and oat straw, show their relative value to be in the above order.

Clover can be successfully and profitably produced on soils of the Willamette Valley and in most parts of the State. Farmers should give more attention to this most excellent forage plant. Timothy is not so valuable a fodder plant as is popularly supposed. It is inferior to either orchard grass or tall oat

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grass. Cheat, or chess, is relatively a poor fodder plant, and should give way to either orchard grass, tall oat grass, or these mixed with clover. Oat straw may be made a greater source of revenue to the farmer by feeding it more than is now done, and using a greater quantity as litter, thereby securing a greater manurial value than by burning. It can well be fed when compounded with more concentrated foods.

In compounding rations it should be remembered that the standards here given are not inflexible rules, but rather guides from which there should not be a wide deviation.



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Oregon Agricultural

EXPERIMENT STATION.

Bulletin No. 40. - January, 1896.

Prunes, Apples, and Pears, in Oregon.



By U. P. HEDRICK.

AGRICULTURAL COLLEGE PRINTING OFFICE,
H. R. CLARK, Printer,
CORVALLIS, OREGON,
1896.

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Oregon Agricultural College.

Corvallis Or., Jan. 1, 1896.

The following bulletin on prune, apple, and pear growing, is respectfully submitted to the fruit growers of Oregon. The teachings and conclusions set forth in this bulletin are largely derived from data collected in making a Survey of the fruit interests of Oregon, an undertaking which was begun by the Horticultural Department of the State Experiment Station, September 1st, 1895, and which will be continued during the summer of 1896. In making this Survey, several weeks were spent by the writer, by Mr. A. H. Carson of Grant's Pass, and by Mr. E. L. Smith, of Hood River, in a careful examination of the orchards of Western Oregon. A large mass of data and observations has been acquired and it is hoped at the conclusion of the work that this may be published in such form that it will be of value to the fruit grower. Meanwhile, the information collected will be the basis of all bulletins upon practical horticulture issued by the Horticultural Department of the Station.

U. P. HEDRICK.

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PRUNE GROWING IN OREGON.



THE prune industry has grown to be one of the most important interests in the state. Already it has assumed greater proportions than all other orchard industries. As the favorite fruit crop of Oregon it has much in its favor; the trees are sure to bear, there are no climatic conditions to overcome, the finished product is not perishable, and its insect pests and fungous diseases are less numerous than other fruits. The trees suffer, it is true, from several pests but they are slight afflictions in comparison to the codlin moth and apple scab of the apple and pear, and, until we have curculio and black knot which render plum growing in the East almost impossible, we can say that prunes are free from diseases. Moreover, there is a growing demand for the product, dried and green, which promises well for the industry.

There are about 26,000 acres devoted to prune growing in Oregon. Prunes are grown throughout the western part of the state and along the Columbia and its tributaries in northern and eastern Oregon, but the major part of the industry is comprised in the Willamette and Umpqua River valleys. In the Willamette Valley, there are about 15,000 acres of prune orchards. As yet most of these orchards are on the black alluvial soil near the river and have not to any appreciable extent encroached upon the red hill soil farther away, though that this soil will produce prunes is certain. The second largest prune district is the Umpqua River Valley. Here there are about 6,500 acres of prune orchards. The valley of the Umpqua seems to be the most favored region for prunes, trees and fruit reaching their highest perfection there. The Petite or French prune especially seems to thrive; the Italian can be as well, and perhaps better, grown in the Willamette Valley. The Petite prune, and the Italian

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more or less, are grown very successfully in the Rogue River Valley also, where there are approximately 1,500 acres. Attempts are being made to grow prunes in Hood River Valley and along the Columbia in eastern Oregon, but experienced orchardists say that these sections cannot well compete with the more favored prune localities, and that their splendid fruit resources can be used to better advantage in growing other fruits. In these districts there are about 2,500 acres.

Climate.—One of the resources of Oregon is its climate. An adequate estimate of its functions and value as a factor in producing prunes, and its influence upon prune growing, would lead us far beyond the limits of a brief bulletin. But some of the practical information gathered from the recent Survey will be in place.

The horticultural effects of the Willamette Valley climate are as follows. All fungous diseases are more prevalent than in higher and drier valleys. The great prune pest of the state, shot hole fungus, finds a more congenial home and is far more rampant in the Willamette Valley than elsewhere. Brown rot, newly introduced into the state, is as yet found only here and will soon be a most grevious pest. In the humid atmosphere, moss and lichens quickly cover the trees. Strong winds, a feature of Willamette Valley climate, make it necessary to head low and prune so as to secure strong, stocky trees. Sunburn is not so common as in the warmer and drier valleys. Fruit ripens from one to three weeks later than in the other valleys. Deficiency in sunlight and summer heat makes the growth of some varieties of prunes unsatisfactory.

The chief horticultural effects of the Umpqua, Rogue, and Hood River Valley climates, are, in comparison with the Willamette; fewer fungous, but more insect pests; woolly aphis, green aphis, San Jose scale, red and yellow spider, are more plentiful, except perhaps in Hood River. There is an earlier and more perfect ripening of fruits, especially those of summer and autumn, because of the continual sunshine and dry air. On the other hand, Italian prunes do not attain their full size and best characteristics because of being forced into early maturity. Injuries from hot winds and sun-scald are more frequent. Local influences governed by topography are much more marked in these valleys, making it important that fruit locations be select-

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ed with great care. More attention must be given to the special conditions and natural agencies which contribute to the development of fruit in any location. The rainfall is much less and the atmosphere not nearly so humid so that in some places prune growers may have, sometime, to resort to irrigation.

The same causes that make the differences in the various valleys, make local variations also, and these need always to be taken into consideration by the fruit grower. There are, for example, all through the state, small valleys, protected from cold winds, and heavy fogs, and open to sunshine, which produce fruits earlier in the season, and of better quality, than locations not so favored. Elevation ministers to the same effect. Rivers moderate climatic influences somewhat. In general, then, the metes and bounds of latitude are set aside somewhat by local modifications, and the intelligent fruit grower who chooses his location in accordance with climatic condition, will find in the climate a valuable ally.

Soils.—Soils and stocks are intimately related, but of the latter we shall speak hereafter. Prunes thrive best in a rich sandy soil, as is well demonstrated by the splendid orchards grown on that soil in Douglas county. The second best soil is the black loam of the valleys, always provided that it is well drained. At present, most of the Willamette orchards are in this soil, and better ones can hardly be produced, when other conditions are proper. The red lands are third in the list of desirable soils, but great care in selecting locations on red lands must be taken in regard to depth of soil. One of the grevious mistakes made by planters all through Western Oregon is that of locating their orchards on shallow soils. This is especially true on the red lands. The minimum depth of soils for prunes is four feet, and as much deeper than that as possible is desirable. Fine prunes are grown on granite soils, but these soils are not lasting and must be irrigated if best results are to be had. The above claims for the various soils are not arbitrary. In fact, location, drainage, and depth of soil have almost as much to do with success in prune growing as does the kind of soil. It must be remembered that there are infinite gradations between the various soils.

The prune tree is a gross feeder, its limbs growing oftentimes several feet in one season, so whatever the soil, it must be rich. On the other hand, a soil may be too rich, producing a

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weak, watery growth not at all desirable. Prunes contain a large amount of water so that it is necessary to have a soil somewhat retentive of moisture, and also one that can be thoroughly tilled, that being essential to proper conservation of moisture. But, as before stated, the land for prunes must be thoroughly drained. This is to be emphasized at all times since one of the great faults of the prune orchards of Oregon is that they are not on properly drained land. Briefly, the ideal soil for a prune orchard is: A rich, sandy loam, warm, mellow and deep, containing sufficient vegetable humus to give lightness and retain moisture without being damp and heavy, and having good natural or artificial drainage. The character of the soil is not to be determined by surface appearance but by thorough examination.

Procuring trees.—Oregon is well supplied with good nurseries and a grower can get first class trees, but many hardly know what they want. One of the chief complaints among the prune growers we visited this fall, was in regard to their young trees. Procuring trees is so largely a matter of business and good judgement, that anything which any one aside from the buyer could say would be of little value, but a word or two in a general way will be proper here. Patronize the nearest reputable nurserymen, endeavoring to get stock at a low price, but not purchasing simply because of cheapness. Buy only first class trees, two years from the bud, having as an ideal, trees of medium size, with straight, stocky, hard growth, clean trunks, free from borers, insects and injuries, and a perfect union of stock and cion. Have your trees shipped as soon as they can be well dug, and set them as soon as possible, having the ground in the best condition. Buy only varieties which show the greatest adaptability to your particular location, a point which seems trite, but which nevertheless is not always observed. Varieties in unsuitable locations and mixed orchards are such common faults that particular attention is called to the fact, that only those which you know will do well should be planted.

Stocks.—Throughout the prune regions visited, perhaps no question awakened as much interest or received as much attention as that of stocks for prunes. The statistics collected by Mr. Carson show that in a little more than nine-tenths of the or-

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chards visited prunes are on peach stocks. Mr. Carson believes, with the prune growers, that the peach *is* the proper stock. But after examining carefully, in this particular, all orchards coming under my observation, and taking the testimony of Prof. Coote, who as horticulturist at the Station, gave the matter attention for several years, the writer is satisfied that peach stocks are used too commonly in Oregon, and that the poor orchards on the heavy, black, damp, or cold soils are largely attributable to the fact that peach stocks *were* used.

Prunes can be and at one time were grown on their own roots, but their habit of sending up suckers condemned this practice. Peach roots were next adopted as a stock upon which to grow them, but in nearly all prune and plum growing regions, excepting the Pacific Northwest, the peach has been discarded for the myrobolan plum chiefly, and the marianna and St. Julien stock somewhat. We know of no experiments in growing prunes upon the latter two stocks in Oregon though extensive trials of prunes on these stocks might lead to valuable results. Any information concerning such trials will be gladly received at the Station.

The writer has but few followers in his belief that the peach is not the *best* stock for prunes in Oregon and so will give his reasons for thinking so pretty fully.

First. The range of soil on which peaches will thrive is very small. There are but few localities where prunes are grown in Oregon in which peaches would thrive at all even if climatic conditions were right. On the other hand the myrobolan plum is a thrifty tree in almost any soil.

Second. Peach roots require better drainage than plum roots. Good plum trees will grow on myrobolan roots, where it would be waste to plant them on peach roots. The importance of this is obvious to those planting on low lands.

Each peach seed produces a tree different from every other one in habit of growth and vigor. Does it not follow that the stocks must vary in their capacity to develop trees? Moreover, the pits in most cases have been obtained from a cannery from immature and poor fruits and there is a constant tendency in trees from such seed to *degenerate*. Stocks from myrobolan and marianna plums are obtained from cuttings, or ought to be, of

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strong, vigorous trees and will therefore produce trees of a more uniform character.

Third. Prunes do not "take" as well on peach roots as on the plums. To do well some varieties, yellow egg for example, ought to be double "worked."

Fourth. Some growers claim the myrobolan to be a dwarfing stock. Wickson says "it is sufficiently free growing in California to suit all purposes, and to form a good foundation for full standard trees." I know this to be true in other states and from reason and observation believe it to be true in Oregon.

Fifth. While plum stocks are susceptible to peach borers they are not nearly so much so as the peach stocks. Diseases affect peach roots oftener than the plum, and their life in general is more precarions than that of the plum so that a prune tree on a peach root is shorter lived than when on plum roots.

Sixth. We have the word of authorities in most other fruit regions that in general the plum roots are better. Wickson, in California says: "Choice of stock should be made according to soil, but unless it is known that there is some local advantages in the use of other stocks, the myrobolan should be used." Taft, in Michigan says: "Plum trees do best on myrobolan stocks though the peach is sometimes recommended for light soils." In the two greatest peach growing states in the Union, myrobolan stocks are recommended for plums.

We cannot help but think that many prune growers in Oregon have made a grevious mistake in selecting trees with peach roots and we advise any one contemplating planting prunes to look into the matter of stocks thoroughly. Only use peach roots when you have a peach soil is the advice we would give.

Preparation of Land.—One of the striking features of Oregon horticulture, as brought out by the recent Survey, is the great need and the great lack of drainage. In all of the orchards visited between Ashland and Portland and Portland and The Dalles, there were only eighteen that had been artificially drained, and not half that many that had been subsoiled. This fact is all the more significant because nearly one hundred of the fruit growers visited gave it as their opinion that their land would be benefitted by drainage, and Mr Carson takes a still more radical view of the situation, and says that nearly half of the prune

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orchards will be practically profitless because of the lack of proper drainage. The whole trend of the information obtained in this Survey points to drainage as one o the great fundamentals of a rational system of horticulture in the valleys of Western Oregon. The need of it can hardly be over estimated and fruit growers must come to look upon the lack of it as the direct and indirect cause of a multitude of the ills of their orchards.

The essential mechanical features of good fruit land demand drainage. There must be an ability to get rid of surplus water if any orchard tree is to grow and thrive, even if the water is only over abundant when the tree is dormant. Proper drainage helps to retain moisture in the dry season, since, if a soil have too much water it becomes puddled, then bakes, and sun and wind quickly evaporate all moisture from it. Well drained land is warmer in spring and fall because of not having the cooler water in it; it is cooler in the heat of the summer, when proper root growth demands an amount of moisture, coolness, and circulation of air, that can not be had in a baked, parched soil. A boggy, miry condition of the soil prohibits cultivation often times when it should be given, and so hinders good tillage. Good drainage makes available plant food that is otherwise lost. By allowing a free passage of currents of air, carrying with them rich substances in the atmosphere, it helps to fertilize a soil.

Subsoiling.—Intimately connected with drainage is subsoiling. What has been said about the necessity of drainage largely applies to subsoiling. It is a peculiarity of Oregon soils that you can not judge the subsoil, with any certainty whatever, from the surface, nor can you infer that the same subsoil extends for any great distance under the same surface soil. Conditions vary so that every fruit grower should examine his soil in several places and judge for himself if any part of his orchard needs subsoiling.

Any soil having an open porous subsoil cannot be benefitted by having the soil made more open. But any soil upon which water stands, or runs off, having a subsoil that is at all compact, and to any great degree impervious to water, ought to be subsoiled. Often times deep plowing will help to accomplish this object. But generally an implement which can be pulled through this compact soil, breaking, and loosening it up, must

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be used. The nature of the soil determines the depth of subsoiling.

Like drainage, subsoiling tends to dispose of surplus water, allowing it to filter through the hard-pan, and also helps to retain it in a dry season, since the water sinks lower in the ground and is not so easily evaporated, but rises gradually by capillary attraction. The act of subsoiling tends at first to dry a soil out, and unless a rain follows before crops are put in may in this way be for a time somewhat injurious. Therefore, subsoiling ought to be done sometime before a crop is planted that the soil may contain the proper amount of moisture. The after cultivation of land that has been subsoiled should be as shallow as possible, thus by mulching, the evaporation is checked and moisture is retained. Such cultivation should be frequent and long continued.

Setting Trees.—There are a few points about setting trees which need emphasizing. It is obvious, first of all, that the rows must be straight. Any man with ingenuity and a "good eye" can secure this result. So far as trimming trees before planting is concerned, it is advisable to cut away all roots which are broken and injured, since a smooth wound will heal more more quickly than a ragged one. Roots of inordinate length may of course be cut back to make a symmetrical root system. When a tree is dug, half of the fibrous roots are left in the ground. The top, therefore, ought to be cut back a corresponding amount, or more so, since it will require some time to resume vital activities. Trees not so trimmed often fail to grow at all, or if they start, are, in their weak condition, destroyed by drouths or pests.

The following rules for tree planting are always in order: The soil should be well firmed about the roots of trees; the roots straightened out in approximately their natural position; the hole should be large and roomy; the earth fine and dry enough to crumble; the tree to be set a little deeper in the soil than it stood in the nursery row; the roots of the tree must not be long uncovered; and every care must be taken to get the tree in the natural environment as quickly as possible. If the operation of tree planting is to be perfect these details must be observed.

Distance Apart.—It is an almost universal fault throughout

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the state for prune growers to plant their trees too close together. The shrewd growers are convinced of this and will tell you not to plant less than twenty-two feet apart. The Petite prune, perhaps, may be well grown at twenty feet. Trees are gross feeders and need plenty of room. Additional reasons for a greater distance apart are, that it allows of better cultivation, enables you to spray more easily, and it will give you a well formed, strong tree with an individuality of its own.

Cultivation.—The most widespread, and the most serious fault of Oregon prune orchards, as I conceive it, after having spent some time among them, is, *neglect.* Commonest among the many things neglected, is neglect in tillage. It must be said that prune orchards in general yield so abundantly without tillage that it is not to be much wondered at that the prune growers think they do not need tillage. Every orchard is so greatly influenced by special soils and conditions in which it grows that it is hard to attribute the behavior of an individual orchard to either tillage or the lack of tillage. But if a man thinks for a moment of the obvious effects of tillage upon any crop in the soil he will see at once that cultivation is essential to any rational system of horticulture. Corn, potatoes, vegetables, all annual crops demand cultivation. Berries and fruits do not differ from vegetables in any of their activities of life, and that which benefits them must be as useful to these. Cultivation must be judicious or grevious damage to an orchard may result. There are underlying principles of the operation which must be interpreted with considerable skill if cultivation is successfully done. Just what proper cultivation is, must be determined by every man, for every farm, and for every season. Only general principles can be given and a few of these are as follows: All young orchards should be given perfectly clean cultivation. All through the state we saw young orchards smothered in weeds the owner thinking it not necessary to cultivate until the trees began to bear. *It is necessary to cultivate the first year* so that the trees may be rightly started and the roots sent deep enough into the ground to escape the plow and cultivator in future years. As the orchard comes into bearing, the cultivation, perhaps, need not be so thorough, the orchard itself, in its wood and fruit, being the indicator o the treatment needed.

Usually, sowed crops should be avoided in an or-

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chard, since they forbid all chance of cultivation and use up plant food and moisture that should go to the trees. Occasionally, on an extremely rich soil, an orchard may be brought into bearing by sowing a crop of grain in it. There is no objection to growing hoed crops or small fruits in a young orchard but the land must be well tilled and well fed, and it must be stopped when the trees come into bearing as there is but little land that can be worked on the share system—a good yield of fruit and of another crop at the same time.

Cultivation should begin as early in the season as possible and should be given *frequently* thereafter until the time to cease comes, which, in this climate, is the middle of July or the first of August, this always to be governed by the growth the tree is making. Early cultivation is important since it warms up the soil, gets it in good mechanical condition, kills the sprouting herbage, and gets the trees quickly to work. It should stop as soon as the tree has completed the desired growth so that it can ripen and harden its wood for the winter.

We are not sure but at this time a *catch crop* of rye, crimson clover, or some other quick growing plant might not be grown to advantnge, to be plowed under in the spring. The merit of such a course would be that the unsightly crop of weeds which springs up after the summer's cultivation is finished, scattering its seeds to the four winds, certainly poor husbandry, would be destroyed; more important than this the mechanical condition of the soil would be greatly improved since it would keep it from running into a molten mass in the winter, would dry it out more quickly in the spring, and add very greatly to the vegetable matter of the soil. It would also aid in ripening the wood of the trees. This matter is only a suggestion however to be thought over by the grower. The practice is becoming a favorite one with Eastern orchardists and is recommended by Eastern writers.

In a young orchard it is advisable to plow the land each year for several years. The after cultivation should be with an implement which with the minimum expenditure of time and labor, will destroy weeds and keep the surface soil loose and friable. There are such a host of good implements that there need be no trouble in finding one suitable for any purpose. Disk harrows,

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spring tooth-harrows, clod-crushers, smoothing-harrows, weeders, and cultivators all have their places. The reversible disk-harrow, we find, is a favorite implement with many Oregon fruit growers. The frequence with which we should cultivate, depends upon the soil, season, and purpose. Cultivating once a week some seasons is not too often especially if its object be to conserve the moisture. A crust should never be allowed to form or weeds to become established. The soil should always be left soft and fine if the fresh and grateful effects of a mulch are to be obtained; when left in this condition the roots are enabled to reach every portion of the soil, thus utilizing a maximum amount of plant food much of which otherwise might remain unavailable. An implement should be used which will allow of working close to trees so that high pruning need not be encouraged on account of close working.

Pruning.—Prune trees, generally, have been fairly well pruned in Western Oregon. It is an operation not at all difficult to learn since the advice given in horticultural books is plain and generally good. Opinions differ as to what the ideal tree, after pruning, should be. The concensus of opinion of the best growers, as we conceive it, after talking with them, would favor a tree about as follows: A medium, low, roundish, symetrical top, upon which the fruit can be readily thinned and picked, the tree easily sprayed, and upon which there are strong branches, that will not break with a load of fruit, and that will shelter the stem from the sun. Such a tree will be vigorous, and long lived. Considerable data regarding pruning was obtained in the Survey, but is of a nature hardly suitable for a short and popular bulletin, however, one can conclude from it that while failures are not often caused by neglect in pruning yet they are aggravated by it, and the experience given in the various reports presses home in the most convincing way the fact that careful and thorough pruning has much to do with the success of a prune orchard. A man of good judgment will not adopt arbitrary rules for pruning, but the following hints, as a guide, may be of value to him.

In forming the head the branches should be distributed upon the different sides of the stock as much as possible. It should be formed by selecting several branches well distributed along the

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stem for a distance of one foot down from the top and pointing in such a way that the head becomes well balanced and symetrical. The strongest upright branch should be left as the leading shoot and be so trained that other branches can be given off from it. Side branches should be well cut back.

After the head is formed an annual pruning should be given though branches or shoots out of place ought to be removed as soon as discovered. In Oregon, prune growers consider late winter the best time to prune but the work can be done any time after the wood has thoroughly ripened and before the buds start in the spring. It is almost a universal fault in a prune orchard to find too much wood. There ought to be just so much wood and so much fruit, to secure which, you may either head back or thin out branches. If headed back, the cut should be made above a bud growing on the upper side of a limb so that the new branch will take a natural upward and oblique position, making a broad, strong branch with great weight bearing power. Be prudent in thinning out the branches of a prune tree as a tree will support many branches, having a tendency to "open up" as the branches become loaded with fruit. Crotches should be avoided, as when two branches of equal size form a crotch it is almost certain that one of them will break.

A pair of pruning shears or a sharp pruning knife is sufficient to do all the prunning needed if the work is undertaken in time. The use of a saw is to be discouraged though it is frequently a necessary evil. In making a cut no projecting spur should be left and the wound should be as small as possible, care being taken not to tear or injure the bark. The cut should always have a good slant. Whenever a wound is made with so great a diameter that it will not grow over in one season, it should be painted with something to keep the wood from checking and rotting. Shellac disolved in alcohol is good, or ordinary paint may be used. To prune intelligently the habit of growth of the tree, whether upright, spreading, or close growing, should be studied. In fact, in practice, it will be found necessary to give every variety of fruit a little different treatment.

Thinning Fruit.—One of the striking facts brought out by the Survey, in regard to profit in growing prunes, was, the much greater net profit in growing prunes of a large size. Net

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profits were almost double in some cases by an increase in size. The question as to why prune growers did not *thin* their fruit and get large prunes was constantly suggesting itself. In looking over the records of the Survey I do not find a dozen men who practice thinning their prunes other than by reducing the wood of the tree by pruning. The best prunes can not be grown, nor really good prunes can not be grown on overloaded trees. The quantity of fruit in bushels will be the same on a tree whether the fruit is thinned or not, and you have for the trouble of thinning a handsomer and much more valuable product. Thinning requires considerable work but if systematically done it resolves itself in a simple job, and, at any rate, the fruit must be picked sooner or later and the work done in June and July saves just so much work when the crop ripens. From this stand point then, it is an extremely short sighted policy not to thin fruit, but there is another factor which makes the operation still more important.

On trees that have had their fruit thinned there are, of course, many less pits, the large fruits being mostly watery flesh. For the formation of the excessive number of pits in the fruits on unthinned trees it requires a much greater quantity of the mineral elements of the soil and since these are the elements most apt to be wanting and most difficult to obtain it is obvious that the growth of a tree, over loaded with fruit, is checked, its vitality weakened, and in the end productiveness lessened.

During most seasons, on trees overloaded, much of the fruit drops. Had this fruit been taken off at the proper time there would have been a much less strain upon the tree. If properly thinned, the danger from "brown rot" or "plum rot," which has shown itself in the State and which threatens to do considerable damage, will not be so great, since the disease is communicated from fruit to fruit, hence will be worst where the fruit is the thickest.

The thinning can be best done when the prunes are about the size of the end of one's thumb, though no set rule can be given for the operation. The quantity of the fruit removed must vary with the size, and vigor of the tree, the variety, and the way in which the tree has been pruned. When the work is done the fruit should be evenly distributed over the tree, making due

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allowance for the size and strength of the various branches. With a little experience a tree can be very easily thinned, the prunes being pulled off in hand fulls. The work is much facilitated if the tree has been well pruned, since pruning in itself reduces the number of fruits to be removed, and makes it easier to get at the fruit on the tree.

Fertilization of prune blossoms.—Important discoveries have been made by workers in the Agricultural Department at Washington in regard to varieties of fruit that are infertile, or somewhat infertile, with themselves,—that is the pollen of a variety does not fertilize the flowers of the same variety but is perfectly potent upon the flowers of another variety. The Clapp and Bartlett pear and Spy and Spitzenburgh apple are notable examples of varieties which are somewhat self-sterile and require trees of other varieties to be mixed with them to secure free fertilization of flowers. The subject is, as yet, but little understood, no experiments of value having been tried with prunes, so we dare not say much that can be construed as at all authoritative. We diligently sought for information upon the subject while making the Survey but could get but little. What we could learn, and observation, lends color to the view that some varieties of prunes, like apples and pears, are inclined to be somewhat self-sterile and that better fertilization is secured in a mixed orchard. The matter is one of great interest and some importance, especially to large prune growers, and the writer will be pleased with any data or information bearing upon the subject.

Insects and diseases.—The following is a brief summary of the number of orchards attacked by the various pestiferous enemies of the prune, as summarized from data obtained on the Survey: All of the prune orchards visited were affected with shot-hole fungus; all had been or were affected by borers; the green aphis had been in forty-one of them during the season. San Jose scale and woolly aphis were found in a few orchards, but orchards were generally, even in infested regions, pretty free from both these pests neither of them being particularly fond of the prune, the bark being so compact that they can hardly pierce it with their beaks. "Canker" was found in fifty-one orchards the disease being the most grevious in the Willamette Valley. A

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small yellow mite, the "yellow spider" was found doing considerable damage in Rogue River, and Umpqua River valleys. "Brown rot" one of the worst fungous diseases Eastern plum and peach growers have to contend with was found in several orchards in the Willamette. Gophers were everywhere abundant and the amount of damage this pestiferous animal does is almost equal to that of all other pests combined, this of course will be lessened as the orchards grow older.

In general, prune orchards were in a very fair condition, in regard to pests, though it was everywhere obvious that all pests were becoming more numerous, and that the necessity for spraying had not existed in the past as it does at present. Prune growers should congratulate themselves that they have not as yet the curculio and black knot, the great enemies of prune culture in the East. Shot hole fungus seems to be firmly established in all orchards; some were but slightly diseased, the foliage of others was completely riddled. Prune growers must take means to keep this disease in check, or, through the defoliation and consequent weakening of the tree the prune crop will be greatly lessened. Only 30 prune orchards had been sprayed and the work in half of them had not been done thorougly.

A spraying bulletin has just been issued from the Station which gives direction for spraying prune orchards, so that the matter only needs to be briefly touched here. For shot hole fungus and all other fungi, spray two weeks after blossoms have fallen with Bordeaux mixture. 10-12 days later repeat. Repeat when fruit is about half grown. After the crop has been gathered, it is well to spray again. For fungi we do not think a winter spraying needful. If a necessity arises for spraying when the crop is nearly ripe, for "brown rot" for instance, use the copper sulphate mixture, 1 pound to 300 gallons of water.

Varieties.—Though other sorts are locally popular, the French, or as it is known in Oregon, the Petite prune, is the universal favorite in the commercial world, and where it thrives among fruit growers. Unfortunately it does not do well in the Northwest except in certain favored spots and so growers must be content to grow a prune not quite so popular in the market at the present time, but one which bids fair to create a special market for itself, and when its good qualities becomes known

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by a more general introduction it may be confidently expected that it will command a price equal to the French prune; and, since it can be only grown to perfection in the Pacific Northwest it is not beyond the range of possibilities that it may become a special product. We speak of course of the Italian prune.

THE ITALIAN PRUNE.—*Fellenburg, German Prune, Swiss Prune.*—Medium size or large roundish but tapering at both ends; suture small but distinct; color dark purple with a heavy bluish bloom; stalk 1 inch long cavity shallow; flesh yellowish green, juicy, parting easily from the stone; flavor sweetish with sub-acid, delicious; tree hardy, vigorous and very productive. It is not known where the Italian prune originated but it has been grown in Italy for a long time, where it finds great favor in its fresh state.

At present the Italian is the recognized prune of the Pacific Northwest. As grown in this section it is superior in quality, size and productiveness to any other prune grown. When dried it is much larger than the French Prune, and its acid flavor makes it more agreeable to the taste for most people. In color the dried product is black or bluish black, in quality it is quite distinct from other prunes, having a most agreeable sub-acid flavor.

PRUNE D'AGEN:—*Petite Prune, French Prune, Prune D'Ente,* and *Robe de Sergent.*—The fruit as grown in Oregon may be described as follows. Medium-sized or small, oval or egg-shaped; suture small, distinct; color, violet purple with bright colored bloom; stem short, slender: cavity small, and shallow; flesh greenish yellow, sweet, full of sugar, rich and delicious, clinging slightly to the stone.

This is the prune which is grown in the leading prune districts of the world. It is known under so may names, there are so many sub-varieties, and the nomenclature in general is so confused that the real Prune D'Agen is hard to identify.

The Prune D' Agen is smaller than most other varieties. It has a larger proportion of solids and sugars and so shrinks less in drying. The lack of acid, however, gives it an insipid flavor and this is the chief defect of the prune when dried, and renders it almost worthless in the fresh state. The qualities that make it so popular are, the wonderful productiveness of the tree, small shrinkage in drying, and its sweetness recommends it to many. The tree is very healthy and vigorous, bearing large crops and rarely failing to yield a crop. It is very particular in regard to soil and climate, doing well only on a rather light, dry soil, and in a warm, dry climate. In Oregon

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these conditions are to be found best in the Umpqua and Rogue River valleys.

SILVER PRUNE.—*Coe's Golden Drop.*—Size large, oval or roundish; suture distinct, one side abnormally large oftentimes, necked; color light yellow, in the sun small red dots; stalk stout, nearly one inch long; flesh yellow, juicy, firm, adhering slightly to the stone; flavor rich, sugary, good quality; tree a vigorous grower and very productive.

It was originaly thought to be a seedling from Coe's Golden Drop, but authorities have decided beyond all question of doubt that the two plums are one and the same, local modifications and conditions changing the fruit so that one might think the one a sub-variety of the other.

The trees are hard to grow and for this reason, as a general thing, the variety has not proved profitable.

The dried product of this variety, if properly prepared, is as fine as any put upon the market, both in size, and flavor for many. Unfortunately, public taste demands that a white prune be sulphured, a process which injures the quality of the product as a food, and which in some markets creates a prejudice against it. The dried prune contains much sugar but has enough acid to give it an agreeable flavor.

REINE CLAUDE.—As yet we are not quite sure about this variety. The Reine Claudes that the writer has seen in Oregon were the old Green Gages grown so extensively in the East. The fact that the Reine Claude of France, the favorite plum of that country, is our Green Gage lends color to the view that the Reine Claude grown in Oregon is the Green Gage, though prune growers deny it. Another year we shall be sure of the matter.

The fruit of the Reine Claude is small; suture faintly marked; color yellowish green sometimes marbled with red; stalk slender, three-fourths of an inch long; flesh greenish yellow, not clinging to the stone, juicy, melting; flavor excellent, very mildly acid, sweetish, unsurpassed. As a dried product, when bleached, it is a bright golden yellow in color and has a delicious flavor.

The Reine Claude will never be one of the great commercial prunes but as a fancy product it is surpassed by none, being almost equal to the best raisins or figs.

WHITE EGG.—*Yellow Egg, Magnum Bonum.*—A very large, oval plum with a neck at the base and a distinct suture; stalk an inch long, not sunk but surrounded by a fleshy ring; color light yellow with a thin white bloom; flesh firm and juicy and clinging to the stone; flavor acid. Not to be recommended for the dried product though it finds some favor in the fresh state.

A few varieties of prunes, several of considerable promise, have originated in the Northwest, among them are the following.

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The descriptions, in the main, are condensed from this year's "Prune Number" of the Rural Northwest, a paper to which we are also indebted for some facts concerning the preceding varieties.

GOLDEN PRUNE.—A prune clearly resembling Coe's Golden Drop or the Silver Prune, being however, a little more rounded, slightly different color, and flavor a little different. The dried product is of excellent quality. The tree, like that of the Silver Prune is not hardy or vigorous. This is its great defect. The prune originated with Mr. Seth Lewelling of Milwaukee, the orignator of the Black Republican and Bing cherries.

WILLAMETTE PRUNE.—A dark ruddy brown prune of the Italian type. Said to be some larger than the Italian, a little sweeter, a little earlier, and to dry heavier. The dried prune is dark much like the Italian. It requires considerable skill in curing. In the fresh state it is hardly surpassed in quality. Originated with Mr. Jessie Bullock of Oswego, Oregon.

TENNANT PRUNE —Another prune of the Italian type, which originated with Rev. John Tennant of Ferndale, Washington. Said to be much earlier in ripening than any of the prunes now generally used. It has been largely planted in the northwest, but enough trees have not come in bearing so that its qualities can be well known.

THE PACIFIC.—A variety having the general characteristics of the Willamette prune. The Pacific is said to be larger and more juicy than the Willamette. Especially recomended for good quality in the fresh state.

THE DOSCH.—A seedling plum coming from Mr. H. E. Dosch of Hillsdale, Oregon. An early and unusually large prune, making a cured prune larger than that of the Italian, though too juicy to dry well. It is sweet and of first class flavor in the fresh state.

CHAMPION PRUNE.—Also an Italian seedling originated by Mr. Bullock of Oswego, Oregon. Earlier than the Italian. Large, round, reddish bloom; flesh firm, good quality, sweet, and parting from the stone easily. Tree productive and a good grower.

Evaporators.—Getting the fruit evaporated is the greatest bugbear the prune grower has to deal with. The evaporators now in use turn out all grades of prunes, and while a poor product may be largely attributed to the care and attention which has been given the operation, yet it is more largely the fault of the evaporators. Herein lies a great chance for improvement and prune growers should begin to give the question considerable thought. The Station has given the matter all the attention possible and hopes before the next crop is evaporated to issue a bulletin upon the subject. Not much can be said in this bulletin, but I can say, after having examined a great number of driers, that I am convinced that steam in steam pipes furnishes the most efficient and economical heat for drying prunes, especially for a large establishment and advise those who contemplate building evaporators to look towards steam as one of

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the means of making better evaporators than we now have. The greatest objection to steam is its cost, but once in use there is such a saving in running the plant that the excess in first cost is soon made up. Steam driers may be built in many localities through some co-operative plan. It is certain that when a few have been built that competition will force all growers, both because of economy and because of the much better product put out, to take their fruit to evaporators using steam.

Steam may be used in an almost endless number of ways to suit circumstances and may be adapted to many styles of evaporators now in use. A great point of merit in a steam evaporator is that the operation of drying the fruit is completely under the control of the operator; chance and "luck" are largely eliminated and a standard product is assured. Another feature not to be lost sight of, is that the steam may be utilized in running graders, parers, dipping apparatus, hoisting fruit, pressing machines, heating water etc, making altogether a thoroughly practical and buisness like establishment. As a model evaporator of this kind the reader is referred to that of Mr. C. H. Richer of Vancouver, Washington. We are well aware of the fact that there are two or three steam evaporators in the state that are not doing good work, but this does not alter our view of the matter as we consider their lack of success due to poor arrangement for carrying off the moisture laden air, rather than the means of furnishing heat.

Shipping fresh prunes.—In the shipping of fresh prunes East one may reasonably believe that a new era has opened for the prune industry. The opening of the era however is too recent to warrant much discussion. The out look is promising indeed for this branch of the industry and has already stimulated into renewed activity growers who were inclined to take pessimistic views of the future of the dried product. The popularization and distribution of good fresh prunes in the East must cause the demands for them to grow until the past few years achivements will appear but little more than a suggestion when the real development has taken place. Because of their tough skins the Italians have, so far, proved the best shippers.

Cost of a Prune Orchard.—At the Experiment Station we are often asked what it costs to produce a bearing orchard. The following, taken from data given by 132 prune growers, is the

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average cost of planting and caring for a four year old prune orchard.

FIRST YEAR.

	Per acre.
Cost of trees, 20 feet apart, at 10 cents each	$10 80
Preparing ground	3 10
Planting trees	3 15
Cultivating	3 20
Total	$20 25

SECOND YEAR.

Cultivating	4 95
Pruning	80
Replanting	40
Total	$ 6 15

THIRD YEAR,

Cultivating	5 05
Pruning	1 45
Spraying	45
Replanting	30
Total	$ 7 25

FOURTH YEAR'

Cultivating	5 15
Pruning	2 05
Spraying	65
Replanting	30
Total	$ 8 15
Total for four years	$41 80

While the data given above was taken from those engaged in growing prunes, it must not be thought that the figures represent more than the *approximate* cost of an Oregon prune orchard The writer believes that the cost is somewhat lower in the average given than the real cost of a *good* prune orchard because, in the statistics given us by the growers many of the needful operations had been omitted, especially true of spraying, thus reducing the average. There were many orchards, too, that were entire failures from which no data was taken.

Profits.—One hundred four and a half dollars, is the average net profit per acre of the 1894 crop, as summarized from the reports of the Survey. The extremes in the figures given us were so great, and the growers seemed to know so little about the cost of the various operations connected with getting the fruit on the market that we hardly know whether we dare recom-

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mend the average given, as even approximately correct. However, it is of interest and will serve as a guide to any one who cares to make estimates on the profits of a prune orchard.

The figures refer to sales in the open market of all grades of fruit. We believe the estimate to be a very conservative one from the orchards from which the data was taken. But the reader need not order trees to plant his farm. Data could not be obtained from the scores of profitless orchards. Moreover, prices are not apt to be so good in the future, as no product of the soil will bring a fancy price through a long series of years. This is not to discourage the real fruit grower, as we believe there is no branch of horticulture that promises greater rewards than prune growing does to the careful and energetic horticulturist. But the lawyer, doctor, preacher, merchant, or the man who fails in the trades and professions, need hardly hope to gain a fortune in growing prunes.

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APPLES IN OREGON.



PPLES are not as plentiful in Oregon as they were a few years ago. The situation seems to be this. The old orchards were largely planted as minor appendages to a general farm. Fruit was grown for home use, and not with the idea of selling it. Years ago these old orchards began to die. On this decreasing orchard area a whole host of pests concentrated their energies; they came unnoticed and without hindrance; moss was allowed to cover the trees and cultivation was neglected. All this was allowed because the incentive for an orchard was in no sense a monetary one. But this is changed, there is now a monetary incentive for an orchard, and thousands of acres of new orchards are being planted and attempts are being made to rejuvenate many of the old ones. We have fewer apples in Oregon to day, then, because this is a transitory period, in the production of apples, between the old orchards, now nearly annihilated, and the new ones not yet in bearing.

The cause of the failures of the old orchards can be remedied.—There are no insurmountable obstacles in the way of growing as good apples, in the land once famous for its "big red apples," as ever have been grown. No great climatic changes have occured since the fine fruit was grown; the soil is the same, with the exception that it has been robbed somewhat of its fertility; and these, climate and soil, are the factors that make a fruit region. To again grow Oregon apples in their pristine beauty and quality, the orchardist has but to renovate or rejuvenate his orchard, by tillage, enrichment of the soil, pruning, and by making warfare upon all pestiferous enemies by spraying. But to do this, apple growing needs and must be made a special industry, to be handled by keen and energetic men.

Favored apple regions.—There are still localities in Oregon, where the apple grower can rely upon the fertility of the soil, the congeniality of the climate, and the immunity from pests and diseases, to produce good apples without much care on his part. The apples that are grown in Hood and Rogue River valleys and Eastern Oregon, fruit unsurpassed in beauty and qual-

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ity, are grown under much the same condition that they grew in Willamette Valley years ago. The lesson to be learned by the horticulturist in these favored spots, from their neighbors in the Willamette Valley, is easy. The splendid young orchards growing in these valleys, should not be neglected,—allowed to go unpruned, the land untilled, and the trees yearly taking the fertility of the soil and nothing returned. Because of present immunity from pests, security from them should not be overestimated. Fungi and insects, numerous and voracious, are already swooping down upon the orchards in these valleys and it behooves individuals and communities to wage war upon them. The future profitableness of apple growing in all virgin apple localities in Oregon, depends upon their now being rightly pruned, sprayed, fertilized, and cultivated.

HINTS ON PLANTING AND CARING FOR AN ORCHARD.

Lack of space prevents going into details in this bulletin with apples, as with prunes. It is hoped that a more comprehensive treatise on the subject may be issued within a few years. However, general principles laid down in the prune part of the bulletin, regarding soils, climate, drainage preparation of land, and cultivation, will be found as applicable to apples as to prunes.

Before planting.—"Well begun is half done." In an orchard, on a badly selected site, or composed of poor varieties, or in which the soil has been imperfectly prepared, all subseqnent treatment will give correspondingly poor results. First of all, then, a fruit grower must be sure that his location and soil are well adapted to apples, and to the particular variety he wishes to grow.

Secondly, a careful study of varieties should be made before trees are purchased, as an error in this direction is a costly one. In general, the behavior of a variety in the planter's own neighborhood is a good indication of its value to him, provided of course that it is marketable. A mistake in selecting varieties once discovered, should speedily be remedied by top grafting. Thirdly, the soil should be in the best possible tilth,—in an all around good condition, before a tree is set.

Locations and soils.—The apple tree is a comprehensive feeder and will thrive on almost any type of good soil. A more

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primal requisite in Oregon is, that the location be a good one. In this state only perfect familiarity with most land will qualify a man to judge of its fitness for an orchard. Bed rock and impervious subsoils approaching the surface make much land unfit for an orchard. Flat wet land and land with "bad spots" which remain cold and sour, and in which trees die out after a year or two, is poor land for an apple orchard even if tile drained, as the soil is apt to be hard and full of clods. Some rolling lands will require drainage because of having stiff, tenacious subsoils near the surface. Familiarity with the "lay of the land," and with its possibilities is necessary to enable a man to judge of its adaptability for an orchard.

Lack of drainage the commonest fault of Oregon orchards.—Too many young orchards are set in undrained land. Undrained land does not admit of proper tillage; plant food is not available; the soil is too cold in the spring and bakes and is too warm in the summer; it does not allow of proper air circulation. Naturally wet, boggy, land, or land with a hard impervious subsoil is unfit for an apple orchard unless it is *thoroughly and systematically drained.*

Preparation of land.—The best way to get a soil in good mechanical condition for an orchard, is to grow some cultivated crop the season before the orchard is to be set. In this way the soil will be made mellow, pernicious weeds will be destroyed, and any "sour places" may be discovered and possibly done away with. It is very essential that the soil be fine and mellow so that the young tree can establish itself well, and send its tender roots deep in the earth, out of the way of the plow and cultivator in the future. Loose, fine earth also acts as a mulch, by destroying capillary attraction, and thus prevents the moisture of the soil from being evaporated.

Planting the trees,—Whether spring or fall planting is best in this climate is hard to say. To plant in the fall and have the trees stand in the water-soaked soil during the rainy season, does not seem right. But when conditions are proper there are many advantages in fall planting. If the ground is well drained, and in good condition, and the trees well matured, apples can be set with best results in the fall. For these reasons; the trees will become established during the winter and will start to growing in the spring before spring planting can be-

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gin; the early growth thus made will enable the tree to better withstand the dry summer which is sure to follow; fall planting saves heeling in; and better trees may generally be had by ordering in the fall. The operation of setting the trees needs to be done with every care, taking all precautions to quickly get the plant in its natural surroundings without injury to it.

I advise not less than 35 feet apart each way for apples. A good safe distance apart allows of many conveniences in working in an orchard and by the added productiveness, arising from better tillage, more plant food, more sun, and more water, will well pay.

Cultivation.—What has been said concerning cultivation of prunes is quite as applicable to apples. It is a safe generalization, to say that an orchard should never be seeded down. Even in growing crops in an orchard that may be cultivated, the temptation to continue doing so is so strong that the orchard sometimes become a minor crop. If necessary to sow grain in an orchard, sow it in strips, running one way between the trees, allowing room to cultivate between the grain and trees. As a temporary expedient an apple orchard may sometimes be thrown in bearing by planting it to grain, but this done, it should be brought under cultivation the following summer.

As stated in the prune part of this bulletin, cultivation should begin the first year; it should begin each spring as soon as the ground is dry enough to allow it; and should be stopped in time for the wood to ripen for the winter.

Since writing the paragraph concerning *catch crops* for prunes, (to which the reader is referred,) my view of the matter has been considerably strengthened, and I wish to urge its practice more strongly than I did in that paragraph. In a paper written by Prof. E. R. Lake for the State Horticultural Society, the value of a catch crop was strikingly shown.

A 25 acre strip in a large prune orchard worked by Prof. Lake, was allowed to become covered with a rank growth of wild mustard. The crop was turned over, and the following season, Prof. Lake says:—"The soil of this mustard strip remained moist and friable all summer through, and with one-third the tillage it presented a more favorable condition for tree growth, as shown by the vigor of the trees, than any other part of the or-

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chard under similar circumstances. The saving in expense of tillage can fairly be estimated at $75.00 as we tilled the rest of the orchard the past year."

We have quoted this passage simply to show the value of such a crop in saving tillage, but there are other effects well worthy of consideration, chief of which is, its office in catching and holding plant food—both nitrogen and the mineral elements; its office in destroying weeds, and its rendering early tillage possible.

The nature of the catch crop must be determined by practice in the different localities. Prof. Lake has been growing vetches and crimson clover as well as the mustard, but at present, prefers the wild mustard which he allows to seed itself. Other possible crops are, oats, rye, buckwheat, peas or rape.

Pruning.—In this short bulletin, it is not intended to enter into a general discussion of pruning. The reader is referred to the horticultural literature upon the subject, much of which, judiciously interpreted, is good, remembering always to prune for advantages peculiar to our climate and your particular location. Pruning to produce fruitfulness in Oregon need never be given consideration, but, on the other hand pruning to reduce the crop by cutting out bearing wood, is sometimes a necessity.

The height to head is greatly influenced by location. The warmer and drier a climate the lower trees should be headed. Low heading has many practical advantages, such as ease of picking fruit, of pruning, of spraying, and less damage from strong winds. But the good health of the tree resulting from shading the trunk is the chief merit of the system. In heading low the limbs must be trained obliquely otherwise there will be difficulty in getting close to the trees with the cultivator. We are not advocating for this climate the California method of pruning, but recommend a mean between their low heading and our high heading, not dispensing, as the Californians do, with a central trunk and strong side leaders.

Self sterile varieties of apples.—The studies of Waite and Fairchild in the Agricultural Department at Washington, have quite clearly demonstrated that some varieties of apples are more or less self-sterile, and that to insure free bearing these varieties ought to be planted in a mixed orchard. The following

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varieties are supposed to be somewhat self-sterile: Gravenstein, Bellflower, Chenango, King, Spy, Melon, Rambo, Red Astrachan, Roxbury Russet, Spitzenburg, Talman Sweet. The only varieties much grown in Oregon that are credited with being self-fertile, are Baldwin, and Greening. Remarks made by extensive growers of Newtown Pippin lend color to the view that this variety is somewhat self-sterile. The matter is one of great importance to those planting large orchards, and it is deplorable that the knowledge upon the subject is so scant and fragmentary. We shall be pleased, indeed, at the Station, to have the results of any experiments, or any experience that the fruit growers may be able to furnish us. The matter we know is receiving some consideration in the state, one large grower has top-grafted alternate rows in a number of acres in his orchard in order to be sure of free fertilization.

Insects and diseases.—Of all fruits, the apple suffers most from pests in Oregon. Out of the 128 apple orchards visited by the Survey workers this fall, all were affected with apple scab and codling moth. A few in Hood and Rogue River valleys were but slightly affected, yet the pests were there. Nearly all were, or had been affected with green aphis. Woolly aphis was found in 86 orchards; San Jose scale in 74 orchards; and "canker" in 83 orchards. Various other insects and fungi were found to a minor extent.

Codling moth and apple scab were to be found everywhere in the Willammette Valley, and but few orchardists had done anything to check either. Exact data concerning the matter was not taken, but it is believed, at a conservative estimate, that nine-tenths of the apples in Willamette Valley were this year made unsalable by these two pests. The outlook for the apple grower would be bad, indeed, were it not for the fact that those who have tried have succeeded in effectually checking both pests by means of fungicides and insecticides. The testimony of several growers to the fact that they had saved 95 per cent of a crop of sound apples should be reasuring to those who doubt the efficacy of spraying. There are many fruit growers who still lack information concerning remedies and their application. This is not a proper place for a detailed consideration of the subject, but briefly, scab and codling moth may be con-

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trolled by the following treatment: A spraying with Bordeaux mixture should be given for apple scab just before the buds swell in the spring. A second one as soon as possible after the blossoms drop and a third 12 to 16 days later; a fourth, if desired, 12 to 16 days after the third. The first spraying for codling moth in Western Oregon should be made between June 6th and June 12th; the application to be repeated about the first of July and on late apples again in the latter part of July and about the middle of August. Paris green,—1 pound to 200 gallons of water to be used for codling moth.

San Jose scale and woolly aphis occasion more loss to the apple orchards in the Umpqua and Rogue River valleys than all other pests combined. Both do considerable damage in the Willamette Valley, the latter especially. The woolly aphis can hardly be annihilated since it lives upon both root and top, but by constant warfare its numbers may be so reduced that the fruitfulness and vigor of the tree, need not be seriously impaired. We have much faith that there will yet be found a root, Northern Spy perhaps, that will resist the woolly aphis, and that the pest can then be controlled on the branches by the caustic washes.

About half of the fruit growers visited this fall, in whose orchards San Jose scale was found, did not know there was any scale there. Yet it may be very readily known. A roughish appearance of the bark of a tree, or a dark spot with edges discolored with red on the fruit; in both cases of which upon examination a small scale is found, and as a distinction from other species of scale, red bloches wherever branch, leaf, or fruit has been stung, are the distinguishing marks. For San Jose scale the lime, sulphur, and salt mixture has given the best satisfaction in this state.

I believe almost every orchard I have visited in Oregon, is affected with green aphis. The pest is a most grevious one, and like the woolly aphis there seems to be no way of annihilating it. Constant spraying with kerosene emulsion, or strong tobacco decoction, are the remedies to keep its numbers reduced.

At present we cannot say much about the "canker" that is causing so much trouble in the young apple orchards. Knowledge concerning it is scant and fragmentary,—to be much added to, we hope, before another season. "Canker" is a fungus

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which spreads from a small infected spot in the bark of a tree to large areas, finally killing the tree. The only known remedy is to cut it out,—the sooner the better of course, and wash the wound with Bordeaux or a solution of copper sulphate. A spraying in the fall after the leaves have fallen will kill many of the spores of the fungus.

There are numerous rusts, mildews, and rots that affect orchards to a minor extent, but all these, at present, we think, will be kept in check by the fungicides that should be used for the more prevalent diseases.

Varieties.—There are practically, for commercial purposes, but seven varieties of apples grown in Oregon: These are, in order of choice as given by the fruit growers interviewed, and I believe in order of acreage of orchards visited: Spitzenburg, Ben Davis, Yellow Newtown Pippin, Baldwin, Red-cheeked Pippin, and Northern Spy. Only a few varieties of apples should be grown in a commercial orchard and these should be selected with special reference to their growth and productiveness in a particular location and to the market for which they are destined. Yet it seems to me that Oregon apple growers could well enlarge upon the number of varieties grown, not as individual growers, but as a whole. All ought not to grow so nearly the same varieties. Fameuse, Canada Red, Greening, Swaar, Roxbury Russet, Wagener, and Wealthy, are all good apples and offer a greater choice of varieties.

I think growers are making a mistake in planting so many Ben Davis apples. While the Ben Davis bears at an early age, is very productive, and is handsome in appearance, yet the quality is wretchedly poor, and in many markets where this has been found out they will not now sell well, and this dislike will of course grow. Moreover, the apple growers in Missouri, Arkansas, and Nebraska, are growing Ben Davis more than any other variety, thus preventing Oregon growers from finding any market at all in the East for the Ben Davis.

In Rogue River and Hood River valleys where the fruit matures earlier than in other sections of the state, a few apple growers will find it profitable to make settings of summer and fall apples. These apples are in demand in northern markets and facilities are good in both the valleys named for reaching

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the selling places. Of course such apples come in direct competition with other autumn fruits, peaches and grapes, so that the demand for them is in this way limited, and commercial orchardists will not find them worth their attention unless they are sure of a special market. Good apples for such a trade are: Red Astracan, Gravenstein, Yellow transparent, Early Harvest, Chenango Strawberry, King, and Duchess of Oldenburg.

Some New Northwest apples.—The Report of the U. S. Pomologist for 1894, describes several promising new apples from the Pacific Northwest. Among these are:

ALMOTA.—A large pale yellowish green apple, stripped and splashed with crimson; conical in shape, somewhat ribbed; flavor mildly sub-acid; quality good; season autumn. Originated with C. R. Mays, of Pullman, Washington.

BLACKWOOD.—Size medium; shape roundish conical. Color light green with brownish blush in the sun; dots conspicuous, russet, raised; flesh yellow with a dark core line, tender, juicy; flavor, mildly sub-acid; quality very good; season winter. Originated with M. L. Smith of Farmington, Wash.

COLFAX.—Very large; shape roundish oblong; stem an inch long, slender; color bright yellow, stripped and splashed with crimson; dots numerous, minute; flesh yellowish, firm, crisp, juicy; flavor sub-acid; quality good; better for cooking than desert; season winter. Originated with Nelson Davis of Colfax, Wash., in 1886. A seedling of Rhode Island Greening.

KLICKITAT.—Size large; shape round, ribbed; stem stout and fleshy; surface smooth and glassy; color yellow marked with carmine and striped with crimson; dots minute to medium, yellow and russet, indented, flesh yellow, coarse grained, tender, moderately juicy; flavor mildly sub-acid; quality good; season winter. Originated with H. C. Cook, White Salmon. Wash., about 1876.

STEPTOE.—Size large; shape roundish, slightly ribbed; stem long slender, fleshy at the connection with the fruit; surface smooth, oily; color pale yellow; dots variable, grayish to brown; flesh yellow, fine grained, crisp, juicy; flavor sub-acid; quality very good; season early winter; tree a strong grower and good bearer. Originated with John R. Reavis, Spokane, Wash., about 1882.

YAKIMA.—A Baldwin seedling now quite well known in Oregon. A winter apple, in appearance much like the King, in flavor like the Baldwin. The Yakima is finding considerable favor.

While visiting orchards with Mr. A. H. Carson in Southern Oregon last fall, Mr. Carson called my attention to some remarkably fine Spitzenburgs in a certain orchard. Across the road, at a little distance, we visited another orchard growing in a different soil and under different conditions. At the first glance we

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hardly knew the fruit. Close examination showed them to be Spitzenburgs but greatly inferior to the first; possibly from the same nursery row as the others, however. What was here so strikingly shown we found true throughout the whole state. The character of the fruit changes, in Oregon with soil, topography and all conditions affecting the growth of fruit, to an extent not dreamed of by one accustomed to Eastern fruit growing. The thought to be derived from this is, that the variety of apples to plant is a local question. Every fruit grower must settle it for himself. When an error is made, top-grafting is the only remedy.

Profit and loss sometimes a matter of using the whole product of an orchard.—Some years even the best orchards will contain such an ill assorted lot of fruit that the profits are small or none at all. There are also many orchards from which the product is never taken. Last fall the writer saw tons and tons of fruit rotting on the ground that might well have been utilized as evaporated fruit or in making cider, jelly, apple butter, or vinegar. These products are all salable at prices that will very materially help in making an orchard profitable. A fruit grower who does not make use of every possible means of profit is neglecting his opportunities and has no right to say that "fruit growing does not pay." Every fruit-growing community should have an establishment, either private or coöperative, to work up the fruit that heretofore has been waste product.

Strains of Varieties.—Part of the variance in apples in Oregon may be explained from the fact that there are so many strains of different varieties. This has been brought about no doubt, largely, from their being introduced from so many different sources. The practical point here is that all trees should be propagated from the best strains. This brings us to another matter which can be best brought out by quoting from L. H. Bailey of Cornell University:

"**It is probable that many trees fail to bear because propagated from unproductive trees.*—We know that no two trees in any orchard are alike, either in the amount of fruit which they bear or in their vigor and habit of growth. Some are uniformly productive, and some are uniformly unproductive. We know, too, that cions or buds tend to reproduce the characters of the tree from which they are taken. A gardener would never think of

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taking cuttings from a rose bush or chrysanthemum or a carnation which does not bear flowers. Why should a fruit-grower take cions from a tree which he knows to be unprofitable?

The indiscriminate cutting of cions is too clumsy and inexact a practice for these days, when we are trying to introduce scientific methods into our farming. I am convinced that some trees cannot be made to bear by any amount of treatment. They are not the bearing kind. It is not every mare which will breed or every hen which will lay a hatfull of eggs."

A FEW NOTES ON PEARS IN OREGON.



THE following notes on pear growing are written with particular regard to conditions in Western Oregon. All the information possible concerning pears was gleaned in the Survey last fall, but such information was scant and fragmentary because of there being but few commercial pear orchards, as yet, in the state. The old pear plantations are seldom more than scattered plantings about the farm yard and along the road-side. Most of these trees were of poor varieties and have outlived their usefulness. In the last few years, however, a new interest in pear growing has been awakened by a demand from the East, for our quite superior pears; this interest has been stimulated no doubt by the somewhat phenominal profits made in a few of the existing commercial orchards.

As yet it can scarcely be said that pear growing can be termed an industry, there being only a few thousand acres of pears in the state. There is every reason to believe that there is profit in the fruit if growers are careful to inform themselves concerning all phases of growing and handling it. The acreage is sure to increase. Rogue River pears ship better, because of firmer texture, than pears grown elsewhere in the state, and in Rogue River pear growing might well be made a special industry. It is well that there be centers for growing fruits, since

*Bulletin 107, Cornell Experiment Station.

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scattered plantations make uncertain amounts of fruit, and buyers will not buy so confidently as they would were the plantations grouped.

It will not be necessary to enter into many details of the cultivation of the pear, because the remarks respecting the apple will apply almost equally for the pear.

Land.—The best land for pears is a deep, mellow, clay loam; or at least the body of the soil should be clay—not hard clay which bakes in the furrows, but that which contains vegetable matter and crumbles under cultivation. Sandy gravelly lands are too deficient in water for the pear. In preparing the land it is important to plow it deep and fit it with great care so that the roots may go deep where they may obtain a liberal supply of water, for pears must not feel the effects of drouths. Flat lands with the subsoil close to the surface should be well tile drained before pears are set upon them, otherwise a weak, unhealthy growth, much subject to disease, and a poorer quality of fruit will be the result.

Distance.—Pears live to a good old age and attain a large size, and while their limbs do not spread comparatively far, yet their roots reach a long distance, so the trees must be given plenty of room. I should say pears ought not to be planted less than 22 feet apart. Even at this distance in old orchards I have seen trees with their branches interlacing, the trees in a pyramidal form at that. All orchard operations,—cultivation, spraying, and harvesting, are made so much easier and the quality of the fruit is so improved by roominess that the loss in number of trees is well made up.

Caring for the trees.—Pears should be given the same tillage recommended for apples. It is generally thought that pears, more than all other fruits may be neglected in the matter of tillage, or that they will do well in sod, but no fruit responds more quickly to tillage than the pear. This is largely because the fruit, to reach its full capabilities, require a great deal of water. The moisture of the soil is well conserved only when good tillage is given. It is therefore especially important that cultivation be begun early in the spring, and that it always be given as soon after a rain as possible. In the Willamette Valley climate, trees are quite apt to make a weak willowy growth that is much subject to blight and other diseases; so it is quite important that

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cultivation be stopped when the tree has completed the required growth. As with apples and prunes I shall recommend that a cover crop of some rank growing grain be sown at this time to force the trees to ripen their wood. The crop plowed under in the spring, will more than repay for itself in fertility added to the soil and expense saved in tillage during the season.

Pruning.—A pear orchard will require but little pruning after the trees have been made to assume the desired shape, which ought to be accomplished in the first four or five years of the tree's life. My ideal pear tree is one with a low, spreading head, with a trunk about three feet high, and with a top consisting of from three to five main branches rising obliquely from the trunk thus assuming the shape of a somewhat pyramidal apple tree rather than the usual spire shaped pear tree.

There are several important advantages gained from this form of tree. First the low spreading head shades the stem and main branches from the hot sun and winds which causes their bark to crack and split, thus admitting germs of blight, and "canker." To obviate this difficulty is a great point in favor of this style of a head. Second, if allowed to grow upright without any checking, the limbs reach the height, in old age, of 40 or 50 feet, and since the fruit is mostly borne near the extremities of the limbs, it can be gathered only by the use of long ladders, thus making harvesting a difficult matter. A third advantage is, the trees can be better sprayed. A fourth is the ground is better shaded and more moisture is retained.

Diseases and insects.—Pear diseases and insects are so many of them common to the apple, that it only needs an enumeration of them here, to serve to call attention of pear growers to them. There are a few pests of the pear not found on the apple and of these a short description will be given.

The apple scab is unquestionably the worst pear pest in this state. It is particularly abundant in Willamette Valley. The only treatment is to spray with the Bordeaux mixture as for scab on apples. The apple moth is not quite so bad on pears as on apples but is nearly so. It is readily checked by the treatment for the apple,—spraying with Paris green. [illegible] is as bad on pears as apples and San Jose scale worse perhaps. The caustic sprays are the remedies. "Canker" should be cut out as soon

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as discovered and the trunk of the tree washed with a solution of copper sulphate.

Pear blight scarcely needs description. It is well known by all pear growers, and yet the records of the Horticultural Survey show that it was present in nearly every pear plantation visited. It is presumed that the reader knows that the disease is caused by a bacillus and is as contagious in an orchard as diphtheria is in the human family. Only the most drastic measures will keep this disease in check. Safety lies in cutting it out as soon as discovered. When the disease has made some headway this seems harsh and entails some labor, but cutting it out is the only way to save the orchard.

The pear mite, *Phytoptus pyri*, is a most pestiferous insect in this state. Last season it was abundant everywhere. Prof. Washburn has described it in a previous bulletin from this Station so it needs no detailed description. It is an insect so minute that it can be seen only by the aid of a lens. It works in the leaves on which it raises a great number of minute, black blisters. There is no specific remedy for the pest. All badly diseased leaves and branches should be removed and burned. In the fall when the insects are migrating, a caustic wash would probably kill great numbers of them.

Pollination.—It is now an established fact that many pears to bear well must receive pollen from another variety blooming at the same time. The following varieties are said, by Waite, of Washington, to bear freely standing alone: Bosc, Duchess, Flemish Beauty, Tyson and White Doyenne. Those said to be somewhat self-sterile, and they include some of our most profitable commercial varieties, are as follows: Anjou, Bartlett, Boussock, Clairgeau, Clapp's Favorite, Columbia, Easter Beurre, Grey Doyenne, Howell, Jones, Lawrence, Louise Bonne de Jersey, Mt. Vernon, Pound, Sheldon, Souvenir du Congres, Superfine, Colonel Wilder and Winter Nelis. The Bartlett, Clapp's Favorite, Flemish Beauty and Seckel, bloom at about the same time, so that in planting the Bartlett it is easy to select a variety to fertilize it. But with the other prominent commercial varieties the task is not so easy. Mr. Coote, at this Station has made some extended observations along this line for several seasons, and with this season to verify them he hopes to be able to tabu-

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late the blooming periods of the leading varieties of not only pears but of other fruits as well. We shall be glad to have the coöperation of all fruit growers in settling this question.

Varieties.—Bartlett and Winter Nelis are the favorite pears in Oregon and they reach their highest perfection in this state. Both are too well known to need description. We recommend them for home and market use. The question of varieties of pears is a local one, as it is with most fruits, and every grower must settle it for himself. Many good varieties of pears have not been tested thoroughly in Oregon yet, and in the following brief descriptions, the qualities given these varieties are those generally ascribed to them.

Tyson and Seckel are the favorite summer pears. Both are nearly free from blight; ship well; grow well; and look well. Though both are highly flavored, the Tyson is perhaps the better and is the handsomer one of the two.

For a fall pear, the Bartlett is, of course, the favorite. Its principal defect is that it generally yields only a partial crop in the "off" year. Clapp's and Flemish Beauty are second and third to Bartlett. Neither ship as well as the Bartlett. Sheldon is one of the best of the fall varieties. Beurre Bosc and Beurre Clairgeau are special favorites with some growers in Oregon. The former is a large, russety pear with a long neck; well flavored, melting and delicious. It ripens the first of October. It is a fairly good shipper. Beurre Clairgeau is yellow, shaded with red; well flavored; the tree grows well and is an early and prolific bearer; good for the market because it ships well; ripens in November.

Garber, Kieffer, and Le Conte are good for quantity and that is about all. A good price may be received for them at first, but the public will not be long imposed upon by fruit as tasteless and insipid as Garber, Kiefier, and Le Conte pear, and Ben Davis apple. All three of these pears are wonderfully prolific, and are quite free from blight. It is said they can well, and that they are fairly good when cooked. Considerable money is being made with them at present in some parts of the South.

In flavor, keeping and shipping qualities, the Winter Nelis is

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far the best winter pear. It is, however, oftentimes a shy bearer and tender in growth. The tree has no beauty to recommend it. The Lawrence is one of the best late pears. The tree is very hardy, and an early and abundant bearer. Anjou is another good winter kind that will sell in any market.

U. P. HEDRICK.

Corvallis, Oregon, Feb. 1, 1896.

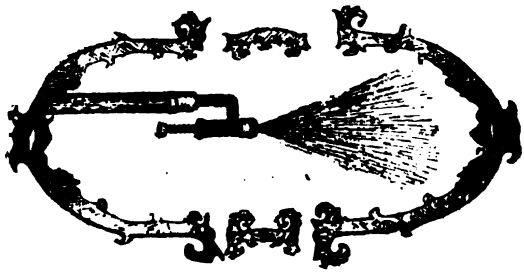


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Oregon Agricultural

EXPERIMENT STATION.

Bulletin No. 41. - February, 1896.



SPRAYING BULLETIN.

By U. P. HEDRICK,
AND
A. B. CORDLEY.

AGRICULTURAL COLLEGE PRINTING OFFICE,
H. R. CLARK, Printer,
CORVALLIS, OREGON,
1896.

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FUNGICIDES FOR 1896.

U. P. HEDRICK.



THE fungous diseases of fruit trees have received attention in so many publications, that it is no longer necessary to give detailed descriptions of them. But spraying methods change from year to year, the results, in the aggregate of preceding years, being a guide for the current year. The purpose of this bulletin, then, is to bring the latest information concerning fungicides before the fruit growers of Oregon. First of all, however, I shall make some observations that occurred to me while making a somewhat extended survey of the fruit interests in the valleys of Western Oregon during the past fruit season.

Why spraying so often fails in Oregon.—One of the prime causes for the failure of spraying in Oregon is, as I conceive it, that Eastern methods of applying remedies have been relied upon too much. We have conditions in Oregon that are all our own, and only our own experience can be a proper guide. The same remedies will destroy the same pests that they do in the East, but there should be a radical difference as to the time to apply them, the strength of the solution, and the number of applications. A second cause of failure is that there are:—

Too many remedies.—The State Experiment Station, the State Board of Horticulture, the horticultural press and various commercial enterprises have recommended various chemical compounds and mixtures, much to the confusion of the fruit growers. This is not meant as a criticism but attention is called to the fault that a step may be taken toward remedying it. The Experiment Station recommends a movement, and is ready to take the initiative in it, that will reduce the number of remedies, and the complexity of their application, and that will evolve a few, simple, cheap, and effective fungicides and insecticides.

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EXPERIMENT No. 1.

CONDITIONS SURROUNDING THE EXPERIMENT.

In this experiment, sheaf wheat was fed to a lot of pigs with the view of testing its merits, as compared with a mixture of grains. Twelve pigs, which had been running on a stubble field since harvest, were selected for the experiment. The pigs were placed in two lots of six pigs each, and the work begun September 3rd. The pigs were nearly pure bred Berkshire,—the fraction of impurity being Poland China.

In weight and in all other characteristics, which could be determined by observation, the lots were very evenly balanced. The age of the pigs, when the feeding began, was about eight months. For weights of the pigs, the reader is referred to Table No. I. showing results by periods. The feeding will be discussed under the heads of Lots 1. and 2. Lot 1, being the pigs to which were fed the mixture of grains, and Lot 2. the ones to which the sheaf wheat was fed. The pigs were fed twice daily, at eight o'clock in the morning, and five o'clock in the evening. Each ration was weighed; and the mixed ration was soaked in cold water from nine to fifteen hours. The pigs were given the use of a small yard, until the ground became muddy, when they were confined to the pen. The pens are built with two compartments, and are provided with plenty of clean straw for bedding. It is just as important to keep a pig in clean comfortable quarters, as any other kind of stock, if the best returns in quantity and quality of product are realized. Charcoal and ashes were in the pens continuously, and salt was mixed with each feed of chopped grain, and was given to the sheaf wheat lot at regular intervals.

For the purpose of answering inquiries, in which people have expressed a doubt, as to the advisability of feeding salt to pigs, we would say that salt will not injure pigs; but on the other hand is relished by them, when fed regularly and not in excessive quantities. Plenty of clean water was given the pigs of each lot. Those fed on sheaf wheat drank considerable water. No more perhaps than those fed on chopped grain; but the latter, took a lage portion of theirs with their feed.

The pigs were weighed every 14 days, and were weighed

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two days in succession at the same hour each day. The mean of the two weights was taken for the record. There has been some criticism upon single daily weights being recorded. The criticism is just, no doubt, and one which every experimenter in stock feeding should heed; but, in case of the pigs in this experiment, and four others, in another similar experiment, which were weighed three days in succession, and the mean taken, there was very little variation. With very few exceptions, the daily weights did not vary more than the amount of daily gain. These exceptions however, were sufficient to warrant the extra pains of making several weights and taking a mean, rather than to publish the single daily weight. This is especially important in experimental work.

RESULTS.

The results are given in table No. I, in periods of 14 days each. A summary of results is found in table No. II.

Lot 1 was fed a mixture, made up of 3 parts chopped wheat, 1 part shorts and 1 part ground oats. The chopped wheat was valued at $16.00 per ton, shorts $11.00, and oats $10.00, making the mixture $13.80 per ton.

This lot made a very rapid gain the first period, making over 3.4 lbs. per day. This is probably due to bringing the pigs in, from the stubble pasture, where they had not received such a liberal diet. The second, and all subsequent periods the gain is less The average daily gain for the whole time, for each pig, was 2.68 pounds. This is shown in table giving summary. For large pigs this is a very fair increase.

The amount of food to make a pound of gain increases gradually, from the first period to the last, except in the 2d period, where there is a sharp rise owing to the falling off in the gain. The pigs were fed a little too much at the outset, so that during the second period they got "off their feed." The average amount of food to make a pound of gain is 4.17 pounds. This is the most favorable result that has been reached in our pig feeding experiments.

The average cost of producing a hundred pounds of live weight, without reckoning the cost of labor, is $2.88. This leaves a margin of profit, when pigs sell for 3 cents on foot, the

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price paid for this lot, at the close of the experiment. The profits would have been greater, if the pigs had been sold a month earlier.

As regards lot 2, or those fed on sheaf wheat, the results are not so favorable. These pigs were fed on sheaf wheat which had been cut and bound in the ordinary way with a binder. The grain was cut as high as the binder could be operated, yet the sheaves contained a large amount of straw. Several samples were threshed, and an average made of the yield of grain to straw. It was found that the wheat yielded 35 per cent of grain. or a trifle over one-third. The wheat was weighed in the sheaf and thrown to the pigs, at the same time that the other lot was fed.

During the first period the pigs in this pen gained 74 pounds against 288½ gained by lot 1. They consumed 1360 pounds of sheaf wheat, which contained 476 pounds of grain. This is 288 pounds less, than lot 1 consumed of the mixture, although the pigs in both cases were given all that they would eat. In the one case, it required 2.6 pounds of grain to make a pound of gain, while in the other it took 6.43 pounds of grain. A bushel o wheat at this rate produced 9.33 pounds of live weight, while 60 pounds of the mixture produced 22.7 pounds of gain.

The cost of producing a pound of gain in lot 2, was 4.28 cents, while in lot 1, it only cost 1.83 cents. The cost of producing a pound of gain, in lot 1, gradually increases through the periods, making an average cost, during the whole time of 4.96 cents, while the average cost in lot 1 was 2.88 cents.

It required 7.44 pounds of grain in the sheaf to make a pound of live weight, while it only required 3.97 pounds of the mixture to make a pound of gain. Then 60 pounds of wheat in the sheaf, made 8.06 pounds of live weight, while 60 pounds of the mixture made 15.11 pounds. At three cents per pound live weight there would be a difference, in favor of the mixture, of 21 cents per bushel. This will pay for the threshing and grinding even under adverse circumstances.

SOME OBSERVATIONS.

1.—It was plainly seen, that the pigs fed on sheaf wheat

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did not relish their food. This interfered very materially in obtaining good results. An animal will not make rapid gains in flesh, when it is compelled to work for its food. This is especially true of the pig. The pigs worked from three to four hours daily, in getting their food from the straw. In case o other animals this might not be as apparent, for they might require some of the coarse food along with the grain, and hence would not separate the wheat from the straw and chaff. The pigs fed on the mixture would eat their ration in a few minutes, and then lie down; and hence all the food consumed became effective in the production of fat. On the other hand in lot 2, rapid assimilation was prevented, by length of time employed in securing the food.

2.—Much of the grain eaten by the pigs fed on sheaf wheat was found whole in the excreta. It was not masticated. The amount found whole in the excreta, was not as great as when pigs are fed on clean threshed grain; but there was enough to account for considerable of the loss in the weights.

3.—The pigs fed on sheaf wheat were not quiet in their pens. Their appetites seemed to never be fully appeased. Hence, they were in constant expectancy for something. This unrest prevented the proper digestion and assimilation of the food received.

4.—More time is required in caring for animals fed in this way, in clearing the straw from the pens.

5.—The feed can not be stored in as small quarters as the threshed grain. Mice, rats, and other vermin will destroy more of the wheat in the straw than when threshed and properly stored in bins.

These are some of the points noted during the process of the experiment, and while some of them might be obviated, they seem to us to be serious objections to feeding pigs on sheaf wheat

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TABLE No. I.

Results by periods of 14 days each.	No. of Pig.	Weight Sept. 3.	Weight Sep. 17.	Gain. lbs.	REMARKS.
1st period Lot 1.....	11	224½	276½	52	Chop'd wheat $16.00 per ton.
	12	186½	241	54½	Shorts, $11.00 per ton.
	13	169	215	46	Oats, $10.00 per ton.
	14	200	240	40	Mixture, $13.80 per ton.
	15	187½	239	52½	
	16	154½	198	43½	
Total gain.....	.....	.....	.....	288½	
Amt. food consumed.	.....	.....	.....	764	
Food for 1 lb. gain.	.....	.....	.....	2.64	
Cost 100 lb. gain.....	.....	.....	.....	$1.83	
		Sept 17.	Oct. 1.		
2d period, Lot 1.....	11	276½	309	32½	
	12	241	266	25	
	13	215	237	22	
	14	240	264	24	
	15	239	269	30	
	16	198	220	22	
Total gain	.....	.....	.....	155½	
Amt. food consumed	.....	.....	.....	780	
Food for 1 lb. gain...	.....	.....	.....	5.01	
Cost 100 lb. gain.....	.....	.....	.....	$3.46	
		Oct. 1.	Oct. 15.		
3d period, Lot 1.....	11	309	350	41	
	12	266	318	52	
	13	237	275	38	
	14	264	306	32	
	15	269	320	51	
	16	220	259	39	
Total gain	.....	.....	.....	253	
Amt. food consumed	.....	.....	.....	980	
Food for 1 lb. gain...	.....	.....	.....	3.87	
Cost 100 lb. gain.....	.....	.....	.....	$2.67	
		Oct. 15.	Oct. 29.		
4th period, Lot 1.....	11	350	385	35	
	12	318	352	34	
	13	275	310	35	
	14	306	335	29	
	15	320	357	37	
	16	259	294	35	
Total gain.....	.....	.....	.....	205	
Amt. food consumed	.....	.....	.....	1063	
Food for 1 lb. gain...	.....	.....	.....	5.18	
Cost 100 lb. gain.....	.....	.....	.....	$3.57	

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TABLE No. 11.

Sheaf Wheat.	No. of Pig.	Weight Sept. 3.	Weight Sept. 17.	Gain. lbs.	Remarks.
1st period, Lot 2.....	5	189½	202	12½	
	6	173	189	16	
	7	154½	169	14½	
	8	261	265	4	
	9	186	200	13½	
	10	163	177	14	
Total gain.....				74	
Amt. sheaf wheat fed				1360	
Amt. grain in wheat.....				746	35 per cent. of sheaf wheat.
Grain for 1 lb. gain.....				6.43	
Cost of 100 lb. gain.....				$4.28	Wheat 40 cents per bushel.

		Sept. 17.	Oct. 1.	
2d period Lot 2.....	5	202	213	11
	6	189	201	12
	7	169	174	5
	8	265	279	14
	9	200	209	9
	10	177	187	10
Total gain.....				61
Amt. sheaf wheat fed				1300
Amt. grain in wheat.....				455
Grain for 1 lb. gain.....				7.46
Cost for 100 lb. gain.....				$4.96

		Oct. 1.	Oct. 15.	
3d period, Lot 2.....	5	213	222	9
	6	201	212	11
	7	174	184	10
	8	279	291	12
	9	209	226	17
	10	187	200	13
Total gain.....				72
Amt. sheaf wheat fed				1400
Amt. grain in wheat.....				490
Grain for 1 lb. gain.....				6.80
Cost of 100 lb. gain.....				$4.53

		Oct. 15.	Oct. 29.	
4th period, Lot 2.....	5	222	231	9
	6	212	225	13
	7	184	195	11
	8	291	303	12
	9	226	233	7
	10	200	208	8
Total gain.....				60
Amt. sheaf wheat fed				1620
Amt. grain in wheat				567
Grain for 1 lb. gain.....				9.45
Cost of 100 lb. gain.....				$6.30

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TABLE No. III.

SUMMARY.

Total gain Lot 1, from Sept. 3, to Oct. 29	902	lbs.
" " Lot 2 " " "	267	"
Gain of Lot 1, over Lot 2	635	"
Total food consumed by Lot 1	3587	"
Amount of sheaf wheat fed to Lot 2	5680	"
Amount of grain in wheat 35 per cent, or.	1988	"
Amount of grain for 1 pound of gain, Lot 1	3.97	"
Amount of grain for 1 pound of gain, Lot 2	7.44	"
Average daily gain Lot 1	2.68	"
Average daily gain Lot 2	.79	"
Cost of 1 pound of gain Lot 1	2.88	cents.
Cost of 1 pound of gain Lot 2	4.96	"
Gain from 60 pounds of grain Lot 1	15.11	
Gain from 60 pounds of grain Lot 2	8.06	lbs.
At 3 cents per pound live weight, the difference in favor of 60 pounds of the mixture is	21	cents,

EXPERIMENT No. 2.

OBJECT OF THE EXPERIMENT.

This experiment was carried on for the purpose of comparing the feeding value of wheat in the sheaf with pure chopped wheat. In the first experiment the object was to compare wheat in the sheaf with an economical mixture of grains. In this experiment economy of food is not so much considered, as a comparative test of wheat in the two forms.

There is a tendency among farmers, since wheat has become a common food for stock, to feed wheat alone rather than to make a mixture with other grains. In this experiment, and in others reported in previous Bulletins, we have shown quite clearly that a mixture is more economical. Oats, when ground and combined with other finer grains, are very good for pig feeding, and are economical, especially when the price falls so low as during the past season,

CONDITIONS OF EXPERIMENT.

Four cross bred Berkshire-Poland-china pigs were selected for this work. They were of the same litter, and were very uniform in weight and external conformation. In three of them there was only four pounds of difference in weight, while the fourth was 13 pounds heavier than the lightest one. The pigs were four months old when the feeding began. They were farrowed April 8th. The feed, previous to the time of experimental feeding, and after the weaning period, which was at

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about eight weeks of age, consisted of shorts and water. The pigs were confined to the pens and yards, the same as those in experiment No. 1. The feeding was conducted as in the previous experiment. The pigs were fed twice each day, at eight in the morning, and four in the evening. The chopped wheat was soaked from 8 to 12 hours, before feeding. Ear tags numbering 1, 2, 3, and 4., were inserted and these numbers are followed in the tables giving weights by periods. The pigs were weighed every 14 days; and they were weighed three days in succession, and a mean of those weights taken for the record. They were weighed the day preceeding the 14th. day, on the 14th day, and the day following.

RESULTS.

The results are given in periods of fourteen days each, as seen in tables 4 and 5. The results are summerized in table 6. During the first period, lot 1, those fed on sheaf wheat, there was an actual falling off of three pounds in weight. This is partially due to the fact, that the pigs did not take well to the feed, only consuming 3 pounds a piece per day. The pigs were not as contented, as those in pen No. 2. In pen No. 2, there was a gain of 26 pounds during the same period. As the experiment progressed the pigs became better accustomed to the sheaf wheat, and made slight gains, until the end of the experiment. The total gain in live weight made by lot 1, was 346 pounds in 126 days, or .6 of a pound per day. Lot 2 made a total gain of 592 pounds in 126 days, or 1.56 pounds per day. This is not as great a gain per day as might have been made by a mixture of grains, basing our opinion upon previous experiments. In experiment No 1, reported in this Bulletin, it will be seen that the daily gain far exceeds that made in this experiment, especially by those fed on the mixture. While a portion of the increase in gain, in experiment No. 1 might be due to individual characteristics, yet a large per cent of it can only be accounted for in a better prepared ration. The sheaf wheat fed to lot 1, weighed 3319 poands, and 35 per cent of this, or 1161.6 pounds, would represent the grain in the sheaf. Lot 2, consumed 1871 pounds of chopped wheat. This makes 7.54 pounds of grain, to produce a pound of live weight, in lot 1, and 4.74 pounds of grain in lot 2. Valuing the chopped grain

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at $16. 00 per ton, and the wheat in the sheaf at 40 cents per bushel, or $13.46 per ton, the cost of food consumed by lot 1, would be $7.74, and $14.96 in case of lot 2. At this rate the cost of making 100 pounds of gain in live weight in lot 1, was $5.00, and in lot 2, $3.80. A bushel of wheat in the sheaf produced a gain of 7.95 pounds, while a bushel of the chopped grain made 12.65 pounds gain in live weight. This makes a difference, in favor of the chopped grain, of 4.70 pounds, which at 3 cents per pound, the price paid for pork on foot, would amount to 13 cents. This is a sufficient margin to more than pay for the threshing and grinding.

There is another consideration in feeding the sheaf wheat, viz.—that the pigs are very poorly fitted for market, when thus fed. The pigs fed on sheaf wheat in this experiment, would not bring as much as those fed on chopped grain, by ½ cent per pound. The pigs were not well filled out; they were lank and lean, better fitted for racing than for the packing house. The small amount of gain made by them, was largely bone, muscle, and sinew, rather than adipose tissue.

From observations and facts, obtained in both of these experiments in feeding sheaf wheat to pigs, we are led to conclude that:

1. Pigs do not like sheaf wheat.

2. The wheat is not well digested.

3. It cost more to put on fat with shea wheat than with ground grain.

4. That a proper mixture of grains will give better results than a single grain.

5. The animal can be better matured when fed with ground grain.

6. More rapid gains can be made with ground grain than with grain in the sheaf.

7. The animal product will command a higher price, when the animal has been fed on ground grain, because it will be better matured. A fat hog is worth more in the market than a lean hog.

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TABLE No. IV.

Fed on sheaf wheat. Wheat 40 cents per bushel in sheaf.

RESULTS BY PERIODS OF 14 DAYS.

	No. of Pig	Weight Aug. 1. lbs.	Weight Aug. 15. lbs.	Gain. lbs.
1st period Lot 1	1	96	96	00
" " Lot 1	2	96	93	—3
Total gain				—3
Grain connsumed				83.6
Cost of food				$ .55
		Aug. 15.	Aug. 29.	
2d period, Lot 1	1	96	103	7
2d period, Lot 1	2	93	107	14
Total gain				21
Grain consumed				116
Cost of food				$ .76
		Aug. 29.	Sept, 12.	
3d period, Lot 1	1	103	119	16
3d period, Lot 1	2	107	114	7
Total Gain				23
Grain consumed				123½
Cost of food				$ .82
		Sept. 12.	Sept. 26.	
4th period, Lot 1	1	119	130	11
4th period, Lot 1	2	114	120	6
Total gain				17
Grain consumed				98
Cost of food				$ .65
		Sept. 26.	Oct. 10.	
5th period, Lot 1	1	130	139	9
5th period, Lot 1	2	120	127	7
Total gain				16
Grain consumed				120½
Cost of food				$ .80
		Oct. 10.	Oct. 24.	
6th period, Lot 1	1	139	149	10
6th period, Lot 1	2	127	138	11
Total gain				21
Grain consumed				149
Cost of food				$ .99
		Oct. 24.	Nov. 7.	
7th period, Lot 1	1	149	162	13
7th period, Lot 1	2	138	146	8
Total gain				21
Grain consumed				157
Cost of food				$1.04
		Nov. 7.	Nov. 21.	
8th period, Lot 1	1	162	174	12
8th period, Lot 1	2	146	158	12
Total gain				24
Grain consumed				157
Cost of food				$1.04
		Nov. 21.	Dec. 5.	
9th period, Lot 1	1	174	182	8
9th period, Lot 1	2	158	164	6
Total gain				14
Grain consumed				157
Cost of food				$1.04

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TABLE No. V.

Fed on chopped wheat, reckoned at $16.00 per ton.

RESULTS IN PERIODS OF 14 DAYS.

	No. of Pig	Weight Aug. 12. lbs.	Weight Aug. 15. lbs.	Gain. lbs.
1st period, Lot 2	3	92	101	9
1st period, Lot 2	4	105	122	17
Total gain				26
Grain consumed				133
Cost of food				$1.06
		Aug. 15.	Aug. 29,	
2d period, Lot 2	3	101	118	17
2d period, Lot 2	4	122	144	22
Total gain				39
Grain consumed				160
Cost of food				$1.28
		Aug. 29.	Sept. 12.	
3d period, Lot 2	3	118	138	20
3d period, Lot 2	4	144	169	25
Total gain				45
Grain consumed				187
Cost of food				$1.49
		Sep. 12.	Sept 26.	
4th period, Lot 2	3	138	157	19
4th period, Lot 2	4	169	188	19
Total gain				38
Grain consumed				196
Cost of food				$1.57
		Sept. 26.	Oct. 10.	
5th period, Lot 2	3	157	174	17
5th period, Lot 2	4	188	215	27
Total gain				44
Grain consumed				216
Cost of food				$1,73
		Oct. 19.	Oct. 24.	
6th period, Lot 2	3	174	195	21
6th period, Lot 2	4	215	243	28
Total gain				49
Grain consumed				224
Cost of food				$1.79
		Oct. 24.	Nov. 7.	
7th period, Lot 2	3	195	223	28
7th period, Lot 2	4	243	269	26
Total gain				54
Grain consumed				224
Cost of food				$1.79
		Nov. 7.	Nov. 21.	
8th period, Lot 2	3	223	247	24
8t period, Lot 2	4	269	297	28
Total gain				52
Grain consumed.				251
Cost of food				$2.00
		Nov. 21.	Dec. 5.	
9th period, Lot 2	3	247	268	21
9th period, Lot 2	4	297	324	27
Total gain				48
Grain consumed				280
Cost of food				$2.24

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TABLE No. VI.

SUMMARY.

	lbs.
Total weight Lot 1, Aug 1st. Sheaf wheat lot	192
" " " 2, " Chopped wheat lot	197
" " " 1, Dec. 5th	346
" " " 2, "	592
Total gain Lot 1 Aug. 1 to Dec. 5	154
" " " 2 " " "	395
Average daily gain for each pig Lot 1	.61
" " " " " " 2	1.56
*Grain consumed by Lot 1	1161.6
" " " 2	1871
Amount of grain for 1 pound gain, Lot 1	7.54
" " " " " " 2	4.74
Cost of food consumed, Lot 1	$7.74
" " " " 2	$14.96
Cost of 100 pounds gain in live weight, Lot 1	$5.00
" " " " " " 2	$3.80
60 pounds of wheat in sheaf produced in gain	7.95
60 pounds of chopped wheat produced in gain	12.65

* 35 per cent of weight of sheaf wheat.

EXPERIMENT No. 3.

FEEDING POTATOES TO PIGS.

During the past two years there have been a great many inquiries made regarding the value of potatoes in fattening pigs. The low price which has prevailed a portion of the time, has made the question of still greater importance. Often the farmer finds himself overstocked with potatoes, which cannot be sold at any price. Under such circumstances the question of feeding them to animals becomes an important consideration.

In many portions of the state the conditions are so favorable for the growth of potatoes, that farmers are considering the advisability of growing potatoes for no other purpose than as a stock food. It is a common practice among farmers to feed potoes to pigs; but there is very little reliable data as to the real benefit derived from such food. That it is important to know, just to what extent, and in what manner, we may feed potatoes and other coarse products of the farm to animals and realize a profit, goes without saying. It is a serious question which confronts the farmer many times, to know how to utilize the by-prodncts of the farm. If we can solve the problem, of how to "gather up the fragments," and turn them to account, we shall have performed an important office.

As a fore-runner of future work along this line, the following

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experiment was carried out. Having a small lot of potatoes on hand, for which there was little demand, we determined to feed them to pigs, and the record of the results is here published.

Ten pigs, eight of one litter and two of another, were separated into two lots of five pigs each. The pigs were weighed and placed in pens making the two lots as nearly equal as possible. The pigs previous to the time of the experiment were fed chopped grain and shorts. The conditions, with reference to the pens in which they were confined, and the time of feeding, were the same as in the previous experiment reported in this Bulletin.

Lot 1, was fed with a mixture of shorts and chopped oats. The grain was wet with cold water and permitted to stand from 8 to 12 hours before feeding. In case of Lot 2, the potatoes were cooked, and the grain was mixed with the potatoes. Enough potatoes were cooked each day for the following day's ration. The grain was weighed and mixed with the potatoes while they were still hot. The potatoes were cooked until they could be readily mashed. This is important for we noticed that the potatoes only partially cooked were not relished so well by the pigs.

Several letters of inquiry have come to the department during the past year, asking about the necessity of cooking vegetables for pigs. It is generally conceeded I believe, that all vegetables such as potatoes, cabbages, squashes, pumpkins, etc., should be cooked before being fed. Pigs may eat them without being cooked but with not so much relish.

Another question has been asked, will such vegetables, when cooked, make a complete ration? To get the best results, grain should be fed with the vegetables. Most vegetables, and especially potatoes, contain a large proportion of starch which in itself is not a complete ration. There should be some nitrogenous material fed with the vegetables, and if mixed with the feed so much the better. In the experiment under discussion, it is a question whether better results would not have been realized, if more nitrogenous material, such as oil meal, oats, or bran would not have given better results than shorts alone. These substances will be tested in future work along this line.

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RESULTS.

Lot 1, received a mixture of one part shorts and two parts chopped oats. This was maintained throughout the experiment. The pigs consumed 6.8 pounds each per day and made a daily gain of 1.8 pounds, or one pound of gain for every 3.8 pounds of food consumed. This is a very good gain for the amount of food eaten, although the average daily gain is not equal to that made by Lot 1, in experiment No. 1, shown in table No. 3.

The cost of producing 100 pounds of gain in live weight in lot 1, is $2.18. This is 78 cents per hundred less than in lot 1, of the previous experiment; and is due to the larger proportion of oats that entered into the ration, The oats were cheaper than either shorts or wheat.

The pigs in Lot 2 consumed 12.4 pounds of potatoes and 2.8 pounds of shorts each per day. They gained 1.3 pounds per day. This is .5 of a pound less than the gain made by the pigs in lot 1. If we substract the amount of grain each pig in lot 2 consumed each day from the grain eaten by lot 1, we shall have 4 pounds which offsets the 12.4 pounds of potatoes eaten by each pig in lot 2. At ten cents per bushel for the potatoes, the price at which they are reckoned in this experiment, then there will be one-half a cent difference in the cost of a days ration in favor of the grain ration. But the grain ration produced one-half a pound more in gain so there is 1½ cents more to be added to this making 2 cents in favor of the grain ration, in the cost of a days feed for one pig.

It cost $2.18 to produce 100 pounds in lot 1, while it cost $2.86 in lot 2. From this experiment, where the potatoes were reckoned at 10 cents per bushel, there was no profit in feeding them. The gain made by lot 2 on potatoes and grain is very satisfactory. The pigs were well matured although the growth was not as great as in lot 1.

An effort was made to increase the amount of potatoes consumed, but the pigs would not eat any more than the amount that was given them. To obtain the best results the ration of potatoes should be decreased and more grain substituted.

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CONCLUSIONS.

1. The pigs made very good gains and were well matured.

2. The grain ration at the prices mentioned gave better results that the potatoes and grain.

3. That a less proportion of potatoes would give better results.

4. That a mixture of grain fed with potatoes would be better than shorts alone.

TABLE No. VII

Pigs fed mixture Chopped Oats, 1 part. Shorts, 2 parts.	No. Pig.	Weight Dec. 13	Weight Dec. 27	Gain lbs
1st period, Lot 1	17	190	217	27
	18	198	227	29
	19	171	191	21
	20	186	199	13
	21	177	198	21
Total gain				111
Grain consumed				437
Food for 1 pound of gain				3.93
Cost of 100 pounds gain.				$2.13
		Dec. 27.	Jan. 10	Gain
2d period, Lot 1	17	217	243	26
	18	227	253	26
	19	191	216	25
	20	199	230	31
	21	198	233	35
Total gain				143
Grain consumed				504
Food for 1 pound gain				3.52
Cost of 100 pounds gain				$2.10
		Jan. 10.	Jan. 24.	Gain.
3d period, Lot 1	17	243	268	25
	18	253	286	33
	19	216	234	18
	20	230	255	25
	21	233	263	30
Total gain				131
Grain consumed				504
Food for 1 pound gain				3.84
Cost of 100 pounds gain				$2.30

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TABLE No. VIII.

Pigs fed on Potatoes at 10 cents per bushel, Shorts $11.00 per ton, Oats $10.00 per ton.	No. Pig.	Weight Dec. 13.	Weight Dec. 27.	Gain lbs.
1st period, Lot 2	22	192	208	16
	23	171	182	11
	24	168	185	17
	25	191	209	18
	26	183	194	11
Total gain				73
Food: Potatoes				840
Food: Shorts				112
Food: Chopped oats				61
Total food				1013
Food for 1 pound gain				13.8
Cost of 100 pounds gain				$3.16
		Dec. 27.	Jan. 10	
2d period, Lot 2	22	208	224	16
	23	182	208	26
	24	185	195	10
	25	209	217	8
	26	194	215	21
Total gain				81
Food: Potatoes				850
Food: Shorts				140
Food: Chopped oats				70
Total food				1060
Food for 1 pound gain				13.08
Cost of 100 pounds gain				$3.12
		Jan. 10.	Jan. 24.	
3d period, Lot 2	22	224	260	36
	23	208	232	24
	24	195	210	15
	25	217	235	18
	26	215	236	21
Total gain				114
Food: Potatoes				910
Food: Shorts				140
Food: Chopped oats				70
Total food				1120
Food for 1 pound gain				9.82
Cost of 100 pounds gain				$2.30

TABLE No. IX.

SUMMARY.

Total gain Lot 1, Dec. 13 to Jan. 24. Mixture of grains	385
Total gain Lot 2, Dec 13 to Jan. 24. Potatoes & grain	268
Total grain consumed by Lot 1,	1445
Amount of grain for each pig per day	6.8
Total grain consumed by Lot 2,	593
Amount of Potatoes consumed by Lot 2,	2600
Amount of Potatoes for each pig per day	12.4
Amount of grain for each pig per day	2.8
Average daily gain by each pig Lot 1,	1.8
Average daily gain by each pig Lot 2,	1.3
Cost of food for 100 pounds gain in Lot 1,	$2.18
Cost of food for 100 pounds gain in Lot 2,	$2.86
Potatoes are reckoned, per bushel	$ .10
Shorts are reckoned, per ton	$11.00
Chopped Oats are reckoned, per ton	$10.00

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FEEDING SHEAF WHEAT TO STEERS.

Some writers in agricultural journals, have advocated the feeding of sheaf wheat to steers, and their opinions have been substantiated by actual feeding tests of this kind. In order that more definite knowledge might be obtained regarding this question, the following feed tests were made, and a summary of results are here presented.

Four grade Polled Angus steers, uniform in quality and general characteristics, were selected and placed in stalls for the feeding operations. They were tied with chains about the neck in stalls three feet in width. This is the method of tying which we have adopted for all the cattle on the farm. The cattle were placed in their stalls a month before the experimental feeding began, so that they would become accustomed to their quarters. These animals had never been tied in stalls before, and some of them probably had never been inside of a barn before. They were what is termed, "long two year olds." That is, they were about 2 years and 9 months old.

For the first month the steers fell off in weight, owing to their shyness, and not being accustomed to the feed. They did not know how to eat grain. They were like one who had never eaten anything but rye bread and beans, being required to eat a dish of oysters. Their stomachs were not adjusted to such living. It requires much patience on the part of the feeder, to induce such animals to take their food. Great care must be exercised in not giving them more than they will eat. A single handful eaten is better than a manger full nosed over, and left to sour, and to become a sickening sight, even to a dumb brute. Water was carried to the animals in the stall. They were not permitted to leave the stall, except when led out to be weighed. The feeding began November 21st, and was continued until February 4th, making 75 days.

The steers fed on sheaf wheat were given corn silage and clover hay with the wheat. They consumed an average of 21.9 pounds each of sheaf wheat per day, 20.2 pounds of silage, and 4.9 pounds of clover hay. The sheaf wheat was fed to them in the bundle just as it came from the field, except the bands were cut before placing it in the manger. The sheaf wheat yielded 35 per cent of grain, hence the actual grain consumed by the

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steers each day was 35 per cent of 21.9 pounds or 7.66 pounds. This is all the animals would eat, Less wheat was wasted by the steers than one might expect. The steers would eat the heads off the wheat, and leave the straw which served as bedding, very little of the straw was eaten.

The steers weighed November 21st, 885 pounds, and 890 pounds respectively, or a total weight of 1775 pounds. February 4th they weighed 960 pounds, and 962 pounds, or a total weight of 1922 pounds. This makes a gain of 75 pounds, and 72 pounds or a total gain of 147 pounds. The average daily gain, for each animal was .96 of a pound. It is somewhat remarkable that the animals should keep so closely together in the gains made. There was 5 pounds difference at the begining, and three pounds at the close of the experiment.

The wheat was not well masticated by the steers, much of it passing off in the excreta. The wheat had a tendency to scour the animals more than the ground grain. Two of the steers were fed on chopped grain, clover hay, corn silage, and oil meal. These were fed under the same conditions as those which were given the sheaf wheat, with a view of comparing the results. The steers were not as promising in their external conformation, as those fed on sheaf wheat. They were 60 pounds lighter in weight, and not as quiet in disposition as the former.

These steers weighed, November 21st, 930, and 785 pounds, or a total weight of 1715 pounds. At the close of the period they weighed 1050, and 917 pounds, or a total weight of 1967 pounds. This gives a gain of 222 pounds or an avarage daily gain for each animal, of 1.96 pounds. In comparing this with those fed on sheaf wheat there is an increase of .73 pounds per day, in favor of the steers fed on the chopped grain.

In the amount of feed consumed, it required 7.82 pounds of grain in the sheaf wheat, to make a pound of gain, and 6.01 pounds of grain to make a pound of gain in case of the steers fed with chopped grain. The steers which were fed on sheaf wheat consumed 760 pounds of clover hay, and 3040 pounds of corn silage. Reckoning the cost of the hay at $4.00 per ton, the silage at $1.00, and the wheat in the sheaf at $13.00 per ton, the total cost of feed consumed would be $10.50. This divided

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by the number of pounds gain, 147, would give $7.13 as the cost of feed to produce 100 pounds gain in live weight.

The steers fed on ground grain consumed 1120 pounds of clover hay, 3040 pounds of corn silage, 1212 pounds of chopped wheat and oats, and 304 pounds of oil meal. Reckoning the clover hay and silage as above, chopped grain at $12.00, and the oil meal at $20.00 per ton, the total cost of feed would be $11.83. This divided by the total gain 252 pounds would give $4.69, the cost of feed for 100 pounds of gain in live weight. Substract this from $7.13 the cost of 100 pounds gain by steers fed on sheaf wheat, leaves $2.44 per hundred in favor of the ground grain. The cost in either case is too great for profit, but for the sake of comparison the results are valuable.

The object in feeding sheaf wheat alone as a grain ration, was to show that the results, whatever they might be, could be attributed to no other feed. The clover hay in the experiment with the ground grain reckoned at $4.00 per ton, is above the cost of production. All of the food materials are reckoned at the market value. From a practical point of view the feeding of steers is more profitable than this would indicate, from the fact that they will convert the coarse material of the farm into a condensed product in the beef produced, and in this way make it marketable, whereas, it is often the case, there is no demand for the coarse products of the farm at any price. These points have been brought out in previous reports on the subject.

A bushel of grain in the sheaf wheat experiment, made a gain of 7.67 pounds, while 60 pounds of the mixed grain produced a gain of 9.98 in live weight. At $3.05 per hundred, the price realized for the beef on foot, it makes a difference in favor of the chopped grain of 7 cents per 60 pounds, or 7 cents on a bushel of wheat. If the wheat can be threshed and ground for 7 cents, then it will pay to take this trouble, if there were no other considerations to be taken into account.

A still more important consideration, however, exists in the fact that animals thus fed are poorly fitted for market. It was apparent to all who saw the animals, that the steers fed on sheaf wheat were not in good condition. They did not mature, and fill out with fat as rapidly as those fed on the chopped grain. Their coats were rough, and their horns were prominent. I be-

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lieve headed wheat would give much better results than wheat in the sheaf. It was not the chaff and fine parts of the straw that gave the steers so much concern, as it was the coarse straw which they were compelled to work over.

CONCLUSIONS.

1. That steers will not gain as rapidly on sheaf wheat as when fed on ground grain.

2. That the animals do not relish the sheaf wheat.

3. It costs more to make 100 pounds of gain in live weight on sheaf wheat, than on ground grain.

4. The difference under all ordinary circumstances is sufficient to pay for threshing and grinding.

5. The animals can not be as well matured on wheat in the sheaf as when fed ground grain, hence a less price will be received for the finished product.

6. The same objections to storing grain in this way, mentioned under pig feeding experiments, will hold true when feeding steers.

7. Better results can be obtained by feeding sheaf wheat to steers than to pigs.

8. Much of the grain consumed is not digested. It has a tendency to scour the animals.

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FEEDING VETCH HAY.

As a preliminary report for the purpose of answering some questions regarding the feeding of vetch hay, I present a brief summary of results of our experience in feeding this material. We have fed the vetch hay to fattening steers, and to cows giving milk, and in both cases the results have been very satisfactory. It was compared with clover hay in both instances. The steers made good gains when receiving vetch hay as the only dry food, except the grain. Two steers were fed 42 days on the vetch hay, and gained 3.07 pounds, and 2.07 pounds respectively, per day. Those fed on clover hay gained 2.16 pounds, and 2.56 pounds respectively.

The vetch when properly cured is relished by all kinds of stock. It must not stand until too ripe before cutting. When fed to milch cows the flow of milk and per cent. of butter fat was maintained throughout the test, which extended over a period of 45 days.

As a cheap substitute for clover hay the vetch seems to answer the demand very satisfactorily. It is an annual consequently must be sown every year. In this respect it can not be compared with clover. As a fertiltzing crop, it is not as good as clover for it does not root as deeply, nor loosen the soil as completely as clover.

This report is only preliminary, and is not intended to take the place of more complete reports regarding experimental feeding of vetch hay later on.

Much credit is due Mr. S. B. Smith, Farm foreman, class of '95, who did the feeding during these experiments.

H. T. FRENCH.

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Oregon Agricultural

EXPERIMENT STATION.

Bulletin No. 43. February, 1897.

AGRICULTURE.



FLAX CULTURE.

H. T. FRENCH, Agriculturist.

The Bulletins of this Station are sent free to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE.
L. M. LELAND, G. M. CLARK, Printers.
Corvallis, Oregon, 1897.

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PLATE I, A TYPICAL SUGAR BEET.

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INTRODUCTION.

In February, 1893, this Station published in Bulletin No. 23 under the title, "The Sugar Beet in Oregon," the results of a series of experiments in sugar beet culture which covered a period of three years. The edition of that bulletin was very soon exhausted. Since the publication of these results, we have been much gratified to note the interest they aroused in the state, and also the attention which has been directed toward our state as one adapted to sugar production. Several attempts have been made in different localities to secure the location of a sugar factory, but through unfortunate combinations of circumstances, and the extreme caution with which any investments have been made in manufacturing enterprises during the last few years, these attempts have achieved no success.

The present publication is intended to review fully the work there presented, and to add such results as have been obtained since the former bulletin. With these results is included information thought to be of value to those interested in this possible new industry in Oregon. We are indebted to a number of publications for the general information, among which are the "Sugar Beet," "The American Agriculturist," and the bulletins of various Experiment Stations.

March 1, 1897.

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PRODUCTION OF SUGAR IN OREGON, FROM AN ECONOMIC STANDPOINT.

H. B. MILLER, Director.

One of the most important industrial questions in the United States, to-day, is how to produce our sugar supply. This is as important to the people of Oregon as to any part of this country. In consideration of this matter, it is of primary importance to examine the economics of it before much effort is wasted.

We must be able, with our soil and climatic conditions, fuel, lime, and other elements employed in the production of sugar, to produce it as cheaply as other sections of the country, or the industry will be short-lived and wasteful. It is well settled that we cannot produce the sugar from cane in competition with the Southern States and the Islands. If other states can produce higher grade beets in unlimited quantities for less money; if fuel, lime, transportation and other factors are greatly in their favor, so that the cost of production and distribution would be less for them, it would not be wise or economical for Oregon to undertake the production of sugar from beets.

The economic theory of supply and demand (a product of a purely commercial era), has given place, under pressure of the present age of science and industrial production, to the law of cost of production, as the regulator of values

The values of things are no longer fixed by the merchant who merely buys and sells; but are regulated by the scientific skill, the ability and judgment of the producer and manufacturer, combined with natural forces. The natural advantages of soil, climate, power, transportation, etc. combined with capital, regulate the price.

The general who directs industrial forces, if he wins in the contest, must be wise in the selection of these elements and a master in directing them. There is a growing fever of excitement throughout this country in the matter of sugar production from beets. Nearly every state has the subject under discussion and rumors are multiplying regarding the erection of factories.

California has achieved the greatest success thus far in the production of sugar from beets, and from reliable reports, it is fair to expect that California will soon have a dozen factories in operation.

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At the present time there are three factories in operation in California, two in Nebraska, one in Utah, one in New Mexico, one in Wisconsin, and one in Canada.

The total consumption of sugar in the United States is about 5,000,000,000 lbs. per annum, and not over one-fifth of it is produced in this country. We have passed the experimental stage in the production of sugar from beets, and it has been clearly proven that the United States can and should produce all of the sugar we consume.

During the last five years it has taken three-fourths of the money received in this country from exported wheat and flour, to pay for imported sugar.

For the past five years over one hundred millions of dollars per annum have been sent to foreign countries for sugar. It seems to be a certainty that this country will very soon stop that outgo of money by producing all of this at home and that mostly from sugar beets. Oregon pays out about one million of dollars per annum for sugar, and her part in this general problem is to determine whether or not she can keep this amount within her boundaries. The question is one to be settled by a scientific and economic examination of the facts involved in production.

The world's consumption of sugar has increased fifty-five per cent in ten years, hence there is no danger of short consumption. The consumption per capita is seventy-nine pounds in England, and sixty pounds in the United States. The cheaper cost will without question, increase consumption; therefore the important question for us to determine is this,—can Oregon produce the sugar from beets and carry it to the people as cheaply as California or other states? We must carefully analyze the elements that enter into the production of sugar from beets, and compare them with the cost of the same elements in other sections.

First:—Can we produce good beets?

Second:—Comparative cost of production,

Third:—Cost of power and fuel,

Fourth:—Cost of lime rock,

Fifth:—Cost of other materials,

Sixth:—Economy of sugar beet industry in its relation to our other agricultural industries.

The answer to the first question will be found in our favor

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after a careful examination of the extended reports herein made by Prof. Shaw. The sugar contents and purity are the factors to be examined to determine the quality of the beets.

The following, taken from a Wisconsin bulletin on beet sugar, by W. A. Henry, is a clear explanation of the relation of sugar contents and purity to the value of the beet:

"In the pages which follow we speak of the per cent of sugar in the juice and the coefficient of purity. Let us understand the meaning of these terms. A hundred pounds of sugar beets contain about 95 pounds of juice. This juice not only contains sugar but various other substances, largely mineral matter, which are a great hinderance, causing serious losses of sugar during the manufacture. A hundred pounds of average beet juice will carry about fifteen pounds of solid matter, of which twelve pounds may be sugar, and three pounds matter not sugar. If we divide the number of pounds of sugar, (12), by the total pounds of solid matter, (15), we get .80 which sum is called the coefficient of purity; that is, beet juice with 15 parts solids, 12 of which are sugar, is said to have a coefficient of purity 80. If the sample of juice contains 16 parts solid matter and 12 parts sugar, as before, then the coefficient of purity is only 75.

When reducing the beet juice to make sugar, each pound of foreign matter, not sugar, keeps at least one pound of sugar from crystallizing. This true, we see at once that the manufacturer desires beet roots not only carrying much sugar, but also with a high coefficient of purity. Immature beets, those grown on soils rich in vegetable matter or fertilized with fresh barnyard manure, those grown on land recently cleared from the forest, or on drained swamp lands, are all liable to carry a great deal of solid matter not sugar in the juice and consequently are quite unsatisfactory to the sugar manufacturer. Large beets are likewise always poor in sugar. The leaf stems of the beet, as well as the crown of the beet root itself also carry much foreign matter. In practice, the manufacturer recovers about seven out of every ten pounds of sugar contained in the beet root."

The following table gives some interesting figures relative to the sugar contents and the coefficient of purity of the sugar beet juice, from several states where sugar is produced together with Oregon and Washington.

	Sugar in juice.	Purity.
Wisconsin, averages,.....	12.44	76
Nebraska, 5 years,.....	13.5	80
Utah, in 1891 averaged,.....	11.0	80
" " 1894 "	12.7	80.2
" " 1895 "	13.5	81.5
Chino, Calif., 1891, averaged...	13.0	80
" 1894-5 "	15.	.....
California, average 5 yrs.....	14.9	83
Washington, 1st result,.....	14.2	82.6
" 1895 2d "	15.2	83.8
Oregon, 1891.....	14.13	78.08
" 1892.....	15.7	78.08
" 1892 to 1897.....	14.9	83.

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The examination in Washington covers twenty-seven counties, and that of Oregon has covered the eastern, southern, and western sections.

One important thing will be observed in this table, viz: that the sugar contents and purity have all been below Oregon and Washington to begin with, and have improved under cultivation.

The quantity of sugar per acre has increased in Utah from 1452 lbs. in 1891, to 3116 lbs. in 1895; and in California at Chino, it has increased from 1888 lbs. in 1891 to 3309 lbs. in 1892. It is only reasonable to suppose that the same would occur in both Oregon and Washington, and in that case, this country would certainly equal, if not excel any part of the United States in the production of the sugar beet.

The second element, the cost of production, is more difficult to determine because of the imperfect data at hand.

In Utah, the average yield per acre in 1891 was 6.6 tons; in 1895 it had increased to 11.5 tons. In Wisconsin the yield in 1896 was about 12 tons per acre; while the estimates from 400 experiments was 15 tons per acre. In Nebraska the yield per acre for 1895 was about 13 tons. The average production of beets per acre in Germany for 1894 was 12.8 tons. In Oregon the average yield, estimated from 40 experiments in different parts of the state was 20.5 tons in 1892, and 23.2 tons in 1893. When we note the fact that the quantity per acre has gradually increased at other places, and when we observe that beets in general are very prolific and thrifty growers all over the state, and when we note the further fact that our climatic conditions give us a good position in the sugar beet belt, we are safe in saying that no other section will excel us in the quantity per acre that we can produce.

We have no definite data from which we can give accurate statements of labor required to produce a ton of good beets. From the reports received at this Station, we feel safe in saying that this state can produce an average of from twelve to fifteen tons per acre at a cost of from $2.50 to $4.00 per ton. The reports from Washington experiments confirm this statement and indicate that this territory, comprising Oregon and Washington, can produce superior beets with a large yield at a low cost, as compared with other sections of the country.

For the third problem,—cost of power and fuel:—the aver-

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age cost of fuel at the various factories now in operation in the United States is $3.50 per ton of coal. The use of wood, coal and water power in Oregon will give us at least equal if not superior advantages of power and fuel.

The cost of lime rock at the various factories ranges from $2.00 to $3.00 per ton. In Southern and Eastern Oregon, the price of lime rock would not exceed this and in some places it would be less. In the Willamette Valley the lime rock would no doubt cost from $3.00 to $4.00 per ton.

The amount of lime rock required per ton of sugar is about one ton, hence its cost is an important item in producing sugar.

The fifth item,— cost of other materials, such as coke, soda, sulphur, tallow, general laboratory supplies, wages, etc., should be about the same here as elsewhere.

The sixth point of examination,—the relation of the sugar beet industry to other agricultural pursuits, is a matter of economy largely in our favor. The residuum has been used both for beef and milk purposes and it is claimed that it has no equal as a milk producer. Oregon is sure to be a great dairy state and there is no better combination than sugar beets and dairying. Every combination for rotation of crops, especially fitting to Oregon, provides for root crops and clover. Nothing would be more certain to develop intensified farming and diversity of crops than the sugar beet industry.

The residuum of lime is of great value, especially in Western Oregon as a fertilizer for our fruit orchards. The product contains 67 per cent of lime carbonate. It is well known that the soils of the Willamette Valley are not overcharged with lime, and this material would be valuable especially in our prune orchards.

From this general examination of the subject, it seems clear that there are no serious obstacles in the way of producing sugar from beets in Oregon. The indications all point in the direction of as low a cost of production as can be had at any point in the country. The opportunities of distribution are such that the industry cannot fail to thrive if the cost of production is low. We shall carry on experiments at the Station and at various other places during the coming season with a view to determine more definitely the elements of quality and value of sugar beets in Oregon.

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A REVIEW OF OREGON SUGAR BEETS.

By G. W. SHAW, A. M., Chemist.

The reasons for undertaking these investigations may be stated as follows: The consumption of sugar in the United States is greater than in any other nation. At present this country does not produce one-fifth of the sugar she uses. To show the sources of this foreign sugar for the last five years the following table is inserted:

TABLE I

*Showing sugar supply of the world from 1890-1895 inclusive.**

SOURCE.	1890-1891 Tons.	1891-1892 Tons.	1892-1893 Tons.	1893-1894 Tons.	1894-1895 Tons.
Germany	1,331,965	1,280,000	1,224,000	1,375,000	1,800,000
Austria	778,873	850,000	793,000	834,000	1,050,000
France	694,537	750,000	580,000	570,000	814,000
Russia	524,000	530,000	450,000	647,000	600,000
Belgium	200,000	295,000	166,000	220,000	230,000
Holland	61,307	50,000	65,000	72,000	90,000
Other Countries	80,000	61,900	97,000	119,000	.....
Miscellaneous†	2,525,649	2,630,000	2,782,000	3,197,000	4,792,000
Total	6,196,331	6,346,900	6,157,000	7,034,000	7,859,000

We can hardly understand why the foreign countries have been allowed to outstrip us to so great an extent, we continuing to import and consume, while there are portions of the United States equally, if not better, adapted to sugar production than France, Germany, or Austria.

Few people realize what the establishing of sugar factories in the United States, in sufficient number to supply the home demand for sugar, would mean. To give some idea of the benefits to be derived and to show the channels which the money would reach, the attention of the reader is invited to the following figures, which are based upon data from the Lehi, Utah, factory:

*Compiled from data in "The Sugar Beet." †Cane sugar.

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Cost of 21,574,000 tons raw material	$115,313,337.00
Cost of fuel	10,867,500.00
Cost of coke	2,753,100.00
Cost of limestone	3,238,112.00
Cost of sal soda	170,750.00
Cost of bags and ducking	5,505,737.00
Cost of tallow	217,350.00
Cost of sulfur	483,000.00
Cost of muriatic acid	281,550.00
Cost of laboratory and other supplies	4,023,000.00
Wages	42,603,562.00
Total that would be expended at home	$185,545,998.00

The cost of machinery and transportation of raw and manufactured material is not included in these estimates: probably they would add a third to the total. But even on this basis we have an expenditure on home industries and labor far exceeding—nearly doubling—that of the value of all the wheat exported from the United States.

Certainly no one will attempt to deny the incalculable benefit to be derived from keeping at home the whole, or even the larger part, of this financial drain upon our country, by supplying the American market with American sugar.

The experiment stations of many states have been investigating this subject for the past few years, and many thousand analyses of American raised beets have been made. In addition, factories have for some years been in successful operation in several states. The nine factories in six states will probably turn out this season not far from 75,000,000 lbs. of granulated sugar. Thus, there is no longer any doubt but there are portions of the United States well adapted to the production of sugar from beets. The initiatory twist has certainly been given to the industry in this country, and we may expect to see a great impetus imparted to it in the near future.

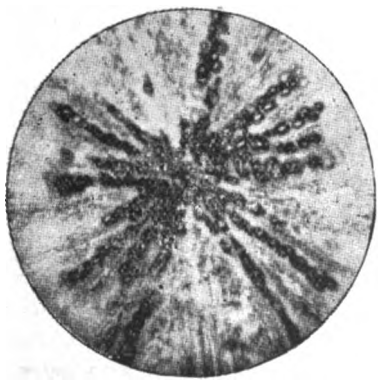
Can Oregon stand in the line of sugar producing states and thus reap the rewards that are bound to follow in the wake of such an industry? Can she not gain the advantages to be derived from the building up of prosperous communities around the factory, furnishing better markets for other home products, and

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encouraging the farmer to adopt more scientific methods of cultivation, which would certainly extend to other farm crops than beets, until its influence would be felt all along the line of agricultural pursuits? If the soil and climate of Oregon is favorable to the production of beets rich in sugar, and economic conditions are inviting, then there is a new and profitable industry possible for our state, one which Mr. Paddock, in a speech before the U. S. Senate, claims is more important than any twenty others in this country. That there is an abundant *home market* is evidenced from the fact that the people of this state alone, according to an estimate on the basis of 60 lbs. per capita and a population of 350,000, consume 21,000,000 lbs. of sugar per annum. It was to seek an answer to these questions that these experiments were conducted.

In the back of this bulletin will be found a table showing analyses of all beets which have been received at the Station in a suitable condition. Analyses numbered from 1 to 96 were made during the season of 1891–1892, and those from 96 to 161 during the season of 1892–1893; the remainder have been made since that time. Following this table wil be found another showing analyses of Oregon grown beets sent to th U. S. Department of Agriculture, at Washington, D. C.

The Beet as a Sugar Plant.



The beet is a hardy, biennial plant, indigenous to Southern Europe, and more recently introduced into Canada and the United States. Internally the beet root is built up of a large number of concentric rings formed of a much larger number of small cells, each of which is filled with a watery solution of small bodies other than sugar. A cross section of the beet is shown in the accompanying illustration. These contain a number of crystalloid salts, as the phosphates, malates, oxalates

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of calcium, and potassium, the salts of the latter being by far the most prominent. The juice also contains a large number of colloid substances, as the albuminous and pectinous compounds. The sugar present in fairly ripe beets is crystallizable and identical with cane sugar.

Crystallizable sugar was obtained from beets in 1847, but it was about a half century later before any success was achieved in its extraction. At first only about three per cent of crystallized sugar could be obtained, although the beet contained from six to seven per cent. The demands of the Napoleonic wars on the one hand, and human needs on the other, continued to concentrate attention upon the beet as a sugar producing plant, until in 1813 a report of the French minister of the Interior stated that during the year past 7,700,00 pounds of sugar had been made, which was the output of 334 factories. In other European countries the industry had assumed a commanding position. From that time to the present there has been a steady growth of the industry till now more than one-half the sugar of the world is made from beets, and instead of receiving a bounty in Europe, as at first, it is now subject to an internal tax. In the meantime, by selection and cultivation, the sugar in the beet has been increased to 15 per cent, a large portion of which, by the improved methods of extracting and purifying, can be obtained as crystallized sugar. The industry has constantly grown in Europe until she now has about 1450 factories in operation.

History in the United States.

Notwithstanding the continuous growth of sugar beet culture in the foreign countries, as indicated above, its early career in this country was marked by a succession of failures, on acount of poor business management and unsuitable locations. As early as 1830 attention was directed to the subject in America by two gentlemen in Philadelphia, without success. David L. Childs, eight years later manufactured sugar from beets, in a limited way, for a short time. There was then an interim of active interest till 1863, when an enterprise was started at Chatworth, Ill., by the Gennet Brothers, from Germany, but the undertaking proved disastrous. The company in order to counteract unfavorable local conditions moved to Freeport in the same state. The

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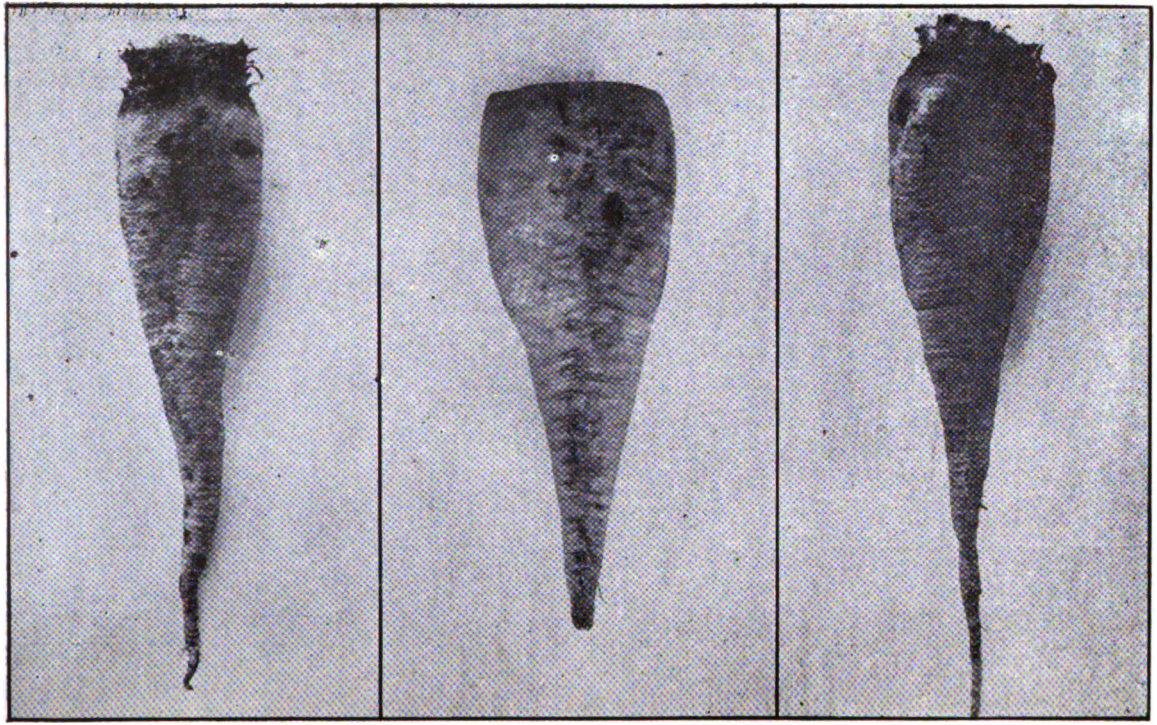


PLATE II, SHOWING BEETS OF GOOD FORM.

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unfavorable climate of this locality, however, finally caused the factory to succumb. In the meantime the industry had made a start at Black Hawk, and Fon du Lac. Wis., both of which proved unsuccessful. The machinery from each of these places was soon moved to Alvarado, California, where the enterprise led a struggling existence till 1876. In 1879 the company re-organized, and since that date, under the efficient management of Mr. E. H. Dyer, has been in successful operation. From this beginning the industry has grown to the proportions before indicated.

What is a Good Sugar Beet?

At the outset of our discussion, I desire to say that many people have a wrong idea as to what constitutes a good beet for sugar purposes. Contrary to a popular idea which is quite extant in the state, the beet should be small, with a large leafy top. Brien says: "The size of the beet is in the inverse ratio of its sugars and salts; the content of water increases with the size and weight of the beet."* In general, the standard adopted seems to be a beet weighing from 1½ to 1¾ lbs., carrying 14 per cent sugar, and having a purity of 80 per cent, although factories will accept beets weighing as high as 3 lbs., and having as low as 12 per cent sugar. In addition good sugar beets should be long tapering roots, without branching rootlets. A typical sugar beet is shown in the *frontispiece*.

The average sugar content and purity for the states where sugar is now being manufactured from beets is as follows:

	SUGAR.	PURITY.
California	14.9	83
Nebraska	13.5	80
Utah	14.5	80
Wisconsin	12.4	76

From a report by Commercial Agent Hawes, of Reichenberg, Aurtria-Hungary:

"The conditions required of a good sugar beet are:

(1) Regular shape (cone, pear or olive shape). Many side roots or prongs are disadvantageous, because they make cleaning more difficult and increase the waste. The leaves should be thick and should be of the characteristic shape and color, and those which lie flat are to be preferred as protecting the beet against frost.

(2) A medium size, say, 1 to 2 pounds. Small beets make a small crop,

*Journal des Fabricants de Sucre, Oct. 23, 1878.

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while large beets contain comparatively little sugar. The length should not be more than 35 centimeters (14 inches).

(3) Rich in sugar—from 9 to 26 per cent

(4) A white, compact, brittle substance. Such beets are more resistant to destruction by storage. A small head not protruding from the ground, as this head must be cut off, containing, as it does, very little sugar.

"It is very important to select the proper variety for a given district, because the different economical conditions of climate and soil require different varieties, if the largest possible crop is to be harvested. It is, therefore, quite necessary for every farmer to experiment with different varieties."

Climate and Soil Conditions.

CLIMATE.—The sugar beet does not differ from other plants in requiring certain conditions of climate and soil to yield favorable results. In foreign countries both of these questions have been pretty satisfactorily settled, but in some parts of the United States, notably California, the conditions that seem favorable, so far as rainfall is concerned, differ very materially from the foreign, hence the latter cannot be taken as an absolute guide.

The season for the growth of beets may be divided into three periods—that of germinating; that of plant formation; and that of sugar storing. The following is a comparative table showing the temperature averages for Germany and certain parts of Oregon during these periods:

TABLE II

Showing Temperature for Periods of Growth.

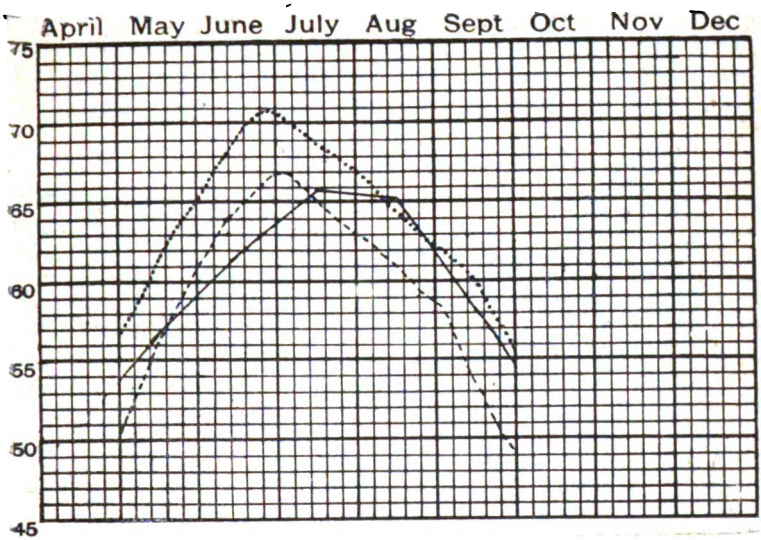
Periods of Growth.	Av. Temp. Foreign.	Av. Temp. E. Oregon.	Av. Temp. Willam. Val.	Av. Temp. South. Oreg.
First	49.1	56.0	52.5	53.3
Second	63.3	65.0	64.4	64.5
Third	56.3	64.5	63.3	54.8

On the opposite page are given comparative temperature charts, which show the normal curve for the leading foreign sugar beet areas, and also for the Willamette valley and Eastern Oregon. That for Southern Oregon is not given since it so nearly covers that of Eastern Oregon as to be essentially a duplicate. Thus it is seen that *in the matter of temperature Oregon seems well suited to the conditions demanded by the sugar beet.*

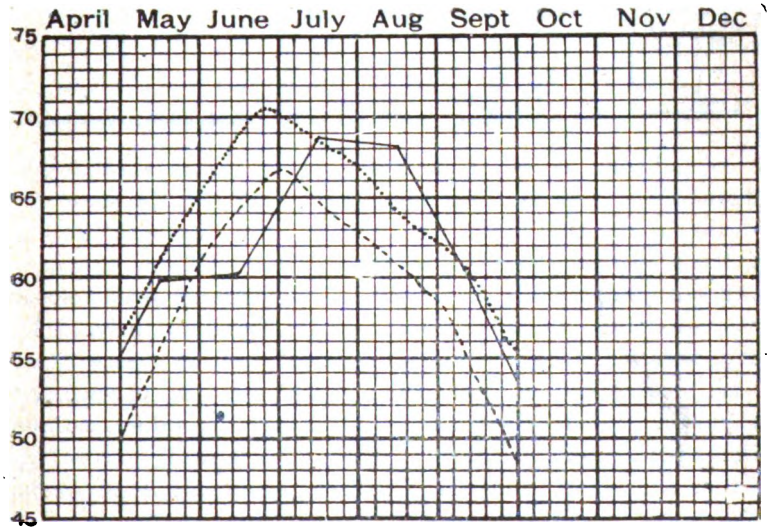
The subject of temperature with reference to the sugar beet has been very carefully studied by Dr. McMurtie, who has constructed his mean isotherm for beet culture at 70° F. for June, July and August. Taking this as a basis, Mr. H. W. Wiley, in his

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Comparative Temperature Charts.



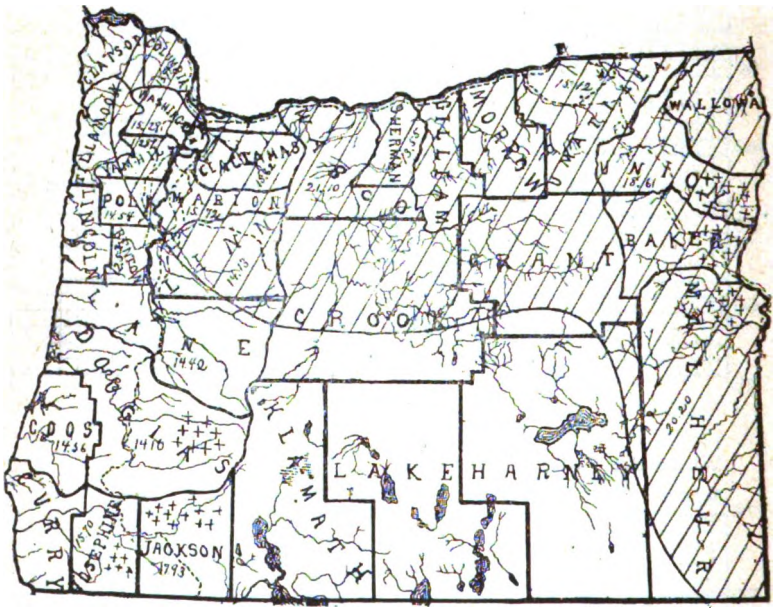
France . .....
Germany - - - - - -
Willamette Valley———————



France .....
Germany - - - - - -
Eastern Oregon ———————

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report on beet culture* gives a map of the United States showing 100 miles on each side of this isotherm, within which area favorable results may be looked for. The inserted map shows this area, shaded, as given for Oregon. On the same map are given the average sugar content for each county, as well as the lime



areas, indicated + +. It is not by any means certain that good sugar beets cannot be raised in other portions of the state than within the 100 mile limit. Concerning this, Bulletin No. 27, of the Department of Agriculture, says: "There are many localities lying outside the indicated belt, both north and south, where doubtless the sugar beet will be found to thrive. The map, therefore, must be taken to indicate only in a general way those localities at or near which we should expect success to attend the growth of sugar beets in the most favorable conditions other than temperature alone." This has already proven true in some instances, and the data here given certainly show that fully as rich beets can be produced outside of this area—in Southern Oregon—as within it.

*U. S. Department of Agriculture, Bulletin No. 27.

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It is in the rainfall of the state that we find the greatest seeming deviation from those portions of the world which are taken as typical beet producing regions. This seeming difference should not be considered as a too serious drawback, nor would it appear so to those acquainted with all the conditions. The average amount of rainfall does not differ much from that of the beet-growing regions of other countries, yet it is not as evenly distributed. It must be borne in mind, however, that the soils of Oregon are much different with respect to their retentiveness of moisture. and that for all our crops the necessary moisture nearly all falls during the "wet season," and for this reason we do not usually consider the *monthly* rainfall as bearing so close relation to the crops as it does in most other states, but rather are wont to consider the *seasonal* precipitation as the more important factor. Consequently tables for seasonal precipitation are given rather than for the monthly. The places chosen are such as *fairly* represent the different portions of the state.

TABLE III

*Showing Seasonal Precipitation.**

LOCALITY.	SPRING. Mch-May	SUMMER. Jun-Aug	AUTUMN. Sep-Nov	WINTER. Dec-Feb	Years Obsvd
LaGrande, Eastern Oregon	4.10	2.26	2.38	15.81	2
The Dalles, Central Oregon	2.93	.88	3.98	8.50	13
Albany, Willamette Valley	10.07	2.43	9.75	22.76	8
Roseburg, Southern Oregon	8.22	1 79	8.00	17.60	10
Newport, Coast Region.....	11.60	8.16†	10.72	34.50	2
Ashland, Southern Oregon	4.79	1.61	4.90	11.63	4
Lakeview, Lake Region.. ...	4.32	3.09	3.18	6.79	3

SOIL.—Beets seem to have little preference in soils, yet they are the most grateful for a sandy loam of considerable depth. Speaking concerning this matter Commercial Agent Hawes says:

"The best soil for quality, as well as quantity of production, according to the experiments of Orth, are those that consist of mild, moist loam about 50 centimeters (20 inches) deep, then loam or marl 1 to 2 metres (3 to 6 ft.), and, under this, sand. Such soils, which are easy to cultivate, have a high degree of absorption, can combine nourishments, and give the plant physically a good start. Such soils are called "natural sugar-beet soils."

Bassett‡ quotes Chaptel as follows :

"Soils which are dry, calcareous, light, etc., are not well suited to the beet. Strong clay soils have little aptitude for the culture of this root. In

*Compiled from State Weather Service data. †For two months only.

‡Guide Practique du Fabricant de Sucre.

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order that the root may prosper, it needs, in general, a mellow fertile soil, the arable stratum of which should be 12 to 15 inches thick. The root succeeds more or less well in all arable soils, but the products vary wonderfully according to the nature of the soil."

"Vilmorin considers that any good soil that will grow wheat and has an arable statum of 12 to 15 inches, will be well suited to this culture."

So far as the chemical constituents of the soil are concerned, phosphoric acid seems to bear the closest relation to the amount of sugar, or, if this be wanting, sugar will not be provided, while a lack of lime would be replaced by potash, soda, or magnesia.

Champion and Pellet consider phosphoric acid as an indispensable base for the formation of sugar in the beet. They classify the order in which the plant food is indispensable as follows: (1) phosphoric acid, (2) lime, (3) nitrogen, (4) potash.

It is foreign to our purpose to discuss, at this time, the soils of Oregon to any length, but in connection with the last statement I desire to direct attention to the fact that the soils of Oregon are well—yes, abundantly—supplied with phosphoric acid, that they surpass those of France in lime, and equal them in potash. Below are contrasted analyses of some of the French sugar beet soils with those of the natural divisions of this state, and those of California. These results, I think, speak for themselves, and need no further comment.

TABLE IV

Showing Average Comparative Composition of Soils.

ANALYSIS OF FINE EARTH	France.		Oregon.			
	Somme	Nord.	Eastern	Willam Valley.	South'n	California.
Insoluble matter	81.80	82.50	66.59	65.18	62.45	67.88
Soluble Silica			13.12	5.02	8.74	8.96
Potash (K_2O)	.06	.14	.43	.23	.34	.64
Soda (Na_2O)	.09		.22	.18	.21	.28
Lime (CaO)	.51	.42	1.22	.83	2 22	1.08
Magnesia (MgO)	.....	.....	.75	.79	.80	1.49
Manganese (Mn_3O_4)	.....	.....	.10	.08	.25	.06
Iron (Fe_2O_3)	2.88	2.18	10.69	16.45	15.35	15.02
Alumina (Al_2O_3)	7.24	8.62				
Sulfuric Acid (SO_3)	.....	.....	.04	.03	.01	.05
Phosphoric Acid (P_2O_5)	.09	.08	.14	.21	.13	.08
Carbonic Acid (CO_2)	.40	.70	.....	.....	.....	.....
Nitric Acid	.....	.....	.....	.....	.....	.....
Hydrochloric Acid	.....	.....	.....	.....	.....	.....
Water and organic matter	5.60	4.84	6.21	10.77	9.52	4 40
Other matter	1.85	1.52	.....	.....	.....	.....
Humus	.....	.....	1.44	1.63	2.25	.75

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PART II.

THE EXPERIMENTS.

Having now compared the climatic and soil conditions of the state with those of the natural habitat of the beet, and found them apparently favorable to its culture, the questions arise as to whether beets rich in sugar will actually be produced under these conditions; whether such beets can be produced at a price a factory can afford to pay, and still leave a fair profit for the farmer. I shall submit in evidence, first, the conditions under which the beets were grown: second, the particular results obtained: third, the yield: fourth, the cost.

When these results are considered and compared with those obtained in other states, and particularly with those obtained in states in which the manufacture of sugar is now being successfully conducted, I believe it will be admitted that none offer greater inducements than are offered in some parts of Oregon.

Seed and Cultivation of the Beets.

Each year arrangements were made with farmers in different parts of the state to cultivate a small plat of beets, the seed being furnished by the Station. Although there was a hearty and ready response to the Station's offer to furnish seed to those who would agree to forward samples for analysis, accompanyed by a report—blanks for which were furnished—there were many who never responded to a single inquiry after they had received the seed, notwithstanding the fact that they had expressly agreed to report results.

The seed used for the experiment was obtained from the Department of Agriculture, at Washington, and of E. H. Dyer, Alvarado, Cal., all of it being imported and the very best that could be obtained. From the former place two varieties were obtained, the Klein Wanzlebener and the Vilmorin Improved; from the latter the Dippe Klein Wanzlebener. In addition to these, a small quantity of Lane's Imperial sugar beet seed from Thorburn, of New York, was planted at the College. The State Board of Commerce distributed some seed throughout the

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state, and a number of beets from parties who received seed from that source were sent to the Station for analysis.

To secure a uniform method of cultivation the following directions, taken from competent authorities in this country and Europe, were sent out with each package of seeds :

Method of growing Sugar Beets to be followed by those taking part in the Co-operative Experiments with Sugar Beets in Oregon.

SOIL.—This should, where possible, be a light loam, preferably containing some lime. The land should be well drained. The beet gets the greater part of its food from the ground at a depth of 8 to 12 inches. Hence freedom from excess of water is necessary.

PREPARATION OF LAND.—The land selected should have been plowed the fall before planting of seed. As soon as it can be properly worked in the spring the land should be plowed again, this time to the depth of 12 inches. Allow to lie until about one week before the time of seeding. Then plow once more to the depth of 4 to 5 inches, and work the soil into a fine and *light* condition (i. e., do not pack it down with a drag). After allowing land to lie 5 to 7 days plant the seed. The object of allowing the land to lie is that sufficient moisture may be drawn from below for the germination of the plant, and that the land may be warmed by the sun, after pulverization. No manure should be applied unless in the shape of well-rotted compost put on in the fall. The land on which the beets are to be grown should be measured approximately, and enough ground planted so that it will be possible to take the eightieth of an acre from the plot without including any *outside* rows. In ordinary soil the rows should be eighteen inches apart; in very rich, less; and in poor soil more than that distance apart. The conditions should be such that the beets cannot attain a greater weight than two pounds each. The seed should be planted one-half to three-quarters of an inch deep, and about 20 pounds of seed to the acre. Plant, when possible, in April.

CULTIVATION.—This should be thorough, and should begin as soon as the plants show in the row. When the beets have put out four leaves, thin them out so as to leave the plants standing about 4 to 6 inches (not farther) apart in the row. The weeds should be kept down and the ground well stirred.

It should be remembered that a beet which grows up out of the ground is worthless for sugar, also that the beets must not attain to a weight greater than two pounds each, and must be smooth and tapering in shape.

EXPERIMENTS OF 1891.—That the results of this season's work may be better interpreted, tables are given below for precipitation and temperature in 1891, and the departure from the normal is also indicated for various parts of the state, the same general regions being taken as are indicated above. These tables are also compiled from the reports of the State Weather Service.

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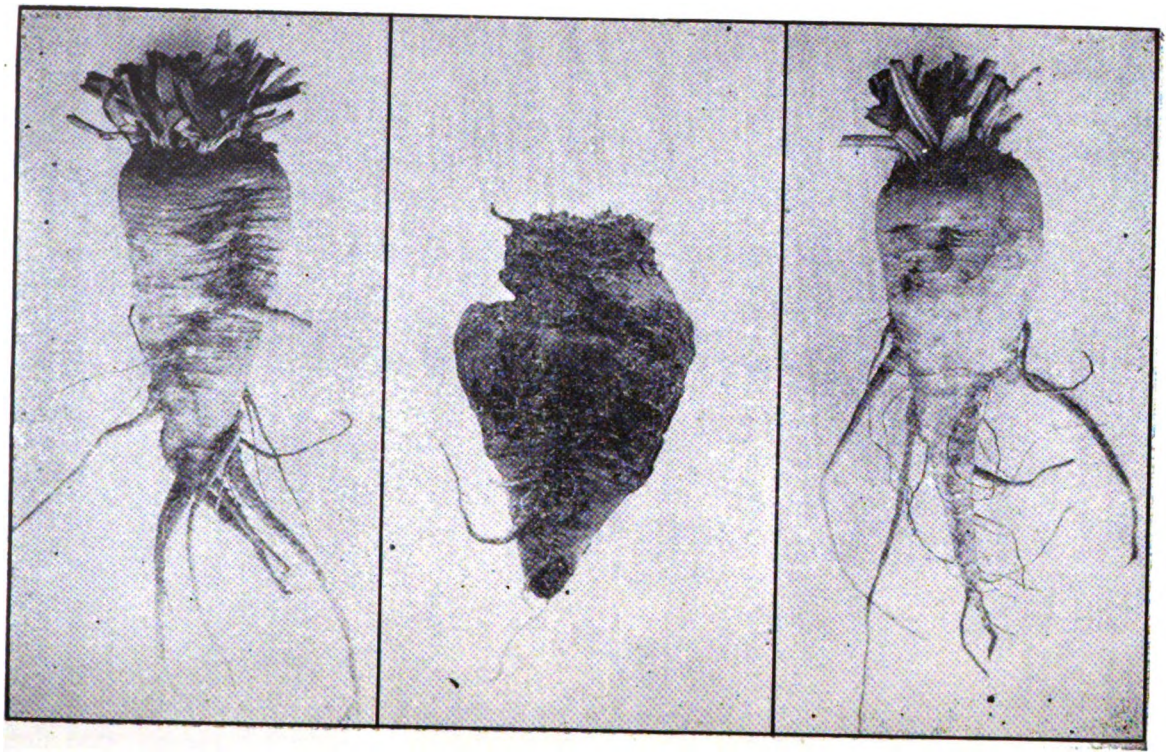


PLATE III, POORLY CULTIVATED SUGAR BEETS.

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TABLE V

Showing Precipitation for 1891.

LOCALITY.	March		April		May		June		July		Aug.		Sept.		Oct.	
	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D
Coast	5.83	-2.01	8.20	†3.67	3.37	† .13	4.33	†2.04	.66	- .52	1.21	†.40	4.18	†1 82	6.46	†0.69
Willam'te Valley	2.39	-2.54	3.46	† .71	1.99	- .26	3.08	†1.30	.30	- .41	.86	†.49	2.36	† .84	5.00	†1.57
South'rn Oregon	2.81	- .03	1.39	- .22	3.22	†1.51	1.92	†1.08	.74	† .49	.33	†.07	1.04	† .29	1.70	-0.17
Eastern Oregon	1.99	- .20	.50	- .41	1.52	- .47	2.68	†1.13	1.45	†1.05	.32	†.07	.61	† .16	0.61	-0.54

TABLE VI

Showing Temperature for 1891.

LOCALITY-	March		April		May		June		July		Aug.		Sept.		Oct.	
	A	D	A	D	A	D	A	D	A	D	A	D	A	D	A	D
Coast	44.6	-1.1	50.2	†1.6	55.	†1.1	57.8	- .7	61.0	†1.4	64.5	†4.8	58.3	† .5	55.7	†2.7
Willamette Vallley	42.9	-3 0	50.4	- .3	57.7	†1.2	58.3	-3.2	96.3	† .6	68.0	†2.8	58.7	† .6	55.2	†3.8
Southern Oregon	46.2	-1 2	51.7	- 9	57.9	-1.1	59.2	-5.0	68.3	- .6	71.0	†3.8	60.9	†1.4	55.2	†2.9
Eastern Oregon	35.6	-5.8	49.7	- .6	58.3	-1.5	58.2	-2.0	69.2	† .3	69.5	†1.2	59.0	† .2	51.5	†3.2

In the tables given above the average temperature and precipitation are given by months in the column marked "A," in the column marked "D" is noted the Departure (plus or minus) from the normal of the respective localities.

It will be noticed that in general the spring rains lasted until quite late thereby causing delay in the time of planting, nearly all of which was done in May, whereas under ordinary circumstances the seed could doubtless be in the ground by the middle of April at the latest.

A great many letters written by the growers to the Station show that the cultivation was not in all cases what could be desired, and the same thing was also indicated by some of the beets received. This seems to be particularly true concerning the preparation of the ground, for many beets were of an irregular shape as shown in *Plate III*, which is made from photographs of beets received at the Station. It will be noticed that these beets are all "scraggly," showing that the ground was not worked to a sufficient depth. The beets shown in this plate are poor, and would not be easily disposed of for sugar purposes. It should always be borne in mind that beets which are profitable for the manufacturer are also profitable for the farmer.

In addition to being irregular in shape, which is of itself bad, branching beets are usually sun-burned, as they have usually been lifted partially out of the ground by their own growth. In some instances beets were received at the Station from which it would be necessary to reject fully one-half the beets as unsuitable for sugar manufacture, because allowed to grow above the ground.

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One of the worst things to befall a beet crop is growth above ground.

The best beets for sugar purposes are the long, tapering roots, without branching rootlets, and if the soil has been properly prepared, and the cultivation has been of the proper kind, beets will always take the tapering form shown in *Plate II.*

RESULTS.—The analyses made at the Station during the season of 1891–1892 may be summarized as follows:

TABLE II

Showing County Averages for 1891.

County.	No.	Sugar.	Purity.
Benton	39	12.30	74.12
Clackamas	7	14.55	77.30
Columbia	1	13.74	79.42
Douglas	9	12.99	73.45
Jackson	3	18.93	80.99
Lane	16	14.32	79.95
Linn	5	13.54	79.91
Marion	1	15.99	78.38
Polk	1	14.72	78.08
Union	3	15.84	79.89
Washington	11	13.96	78.79
Yamhill	1	10.73	76.64
Average		14.13	78.08

An examination of the results reveals that the analyses had a wide range, viz: from 6.77 per cent to 22.44 per cent sugar in in the juice. Of the 95 analyses made 8 fell below 10 per cent; 76 showed over 12 per cent, and 37 over 14 per cent sugar. An average of 81 analyses for the Willamette Valley shows 13.76 per cent sugar and a purity coefficient of 77.89; the average beet weighing a little over 1¼ pounds, while an average of 10 analyses of beets from Southern Oregon showed 13.38 per cent sugar with a little larger beet. For the entire state the average weight was 608.5* grams; sugar in juice, 14.13 per cent; purity, 78.08 per cent.

The results obtained from the different kinds of seed were as follows:

Klein Wanzebener	14.3	Sugar in Juice.	79.0 Purity.
Dippe Klein Wanzebener	13.2	" " "	77.1 "
Vilmorin Improved	13.4	" " "	76.2 "

YIELD AND COST.—An attempt was made to collect reliable

*One pound = 453.5 grams.

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data as to these items, but the reports received were very meagre. The average of all reports concerning yield was 20.5 tons per acre, the extremes being 5.1 and 44.2 tons. The yield as reported is given below.

TABLE VIII

Showing Estimated and Theoretical Yield.

GROWER.	Post Office.	County.	Reported Yield in Tns.	Theoretical Yield in Tons.*	Probable Yield of Sugar per acre.
Edward Albright	Ashland	Jackson	12.0	10.18	3584.0
A. W. Lucas	Monmouth	Polk	30.0	27.50	8832.0
D. S. K. Buick	Roseburg	Douglas	25.0	.....†	2385.8
H. C. Perkins	Llewellyn	Lane	18.0	32.50	4386.4
J. Voorhees	Woodburn	Marion	21.5	40 50	6184.2
J. S. Powell	Philomath	Benton	32.7	15.80	9364.6
W. E. Smith	Vale	Malheur	20.0	15.40	7076.0
J. H. Rinck	Buxton	Washington	17.4	9.90	5056.4
John Henry	Beaverton	Washington	5.1	21.10	1287.2
R. Scott	Milwaukee	Clackamas	44.2	53.40	9025.6
J. H. Crow	Lorane	Lane	11.0	9.50	3130.6
C. D. Thompson	Corvallis	Benton	5.1	21.10	1287.2
Average			20.5	23.34	5133.3

So far as reports were received, the cost of production ranged from $11.25 to $24.18 per acre, some including harvesting and some not, which represented all hand work. This subject is treated more definitely later in the bulletin.

Considerable disappointment is felt that farmers to whom seed was sent in the majority of cases did not take the trouble to report more carefully the two items of yield and cost. These are two vital items to the farmer—the very ones which affect him most. It matters little how high a per cent of sugar Oregon beets contain, i they cannot be produced at a price a factory can afford to pay, we may just as well stop all talk about the industry. Right here I desire to urge upon any who may undertake future work the *absolute necessity* of reporting these two items estimated as closely as possible.

EXPERIMENTS OF 1892.—For the investigations of 1892 the following varieties were used, Desprez' Early Rose, Vilmorin Improved, Klein Wanzlebener, and White Imperial, all of which

*The so-called theoretical yield assumes there are 40,000 beets to the acre, which in general holds true or beets weighing less than 800 grams.

†Weight of beet over 800 grams. See previous note.

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are favorite kinds, the first being much used in California. Unfortunately the seed was delayed iu reaching us, so it could not be distributed to the farmers as early as it should have been to secure the best results. Had the seed reached us in due time, it could have been put into the ground in April for at that time there was favorable weather for seeding, but by the time the seed had been distributed cold weather set in and continued till May, after which the weather became very dry rendering the conditions for a fair trial very unfavorable. The temperature conditions for the season are indicated on the charts given on the following page, which also give the normal temperature for this and the previous season. The rainfall for the season was below the normal and reports all read "very dry," "extraordinary dry," "weather very unfavorable." In fact nearly all the beets in the eastern portion of the state failed to mature, and in many instances the seed failed to germinate. So far as the season's climate is concerned, then, the experiments were greatly handicapped and we were "in pursuit of knowledge under difficulties."

The cultivation for this season was the same as for the previous year except that the rows were placed 20 inches apart.

Owing to the disturbed condition of the experiment the results are doubtless poorer than would have been the case had the season been one of more nearly normal condition. Still the results confirm the conclusions of the previous year, that Oregon possesses the conditions necessary for the production of excellent beets for the purpose of beet sugar manufacture.

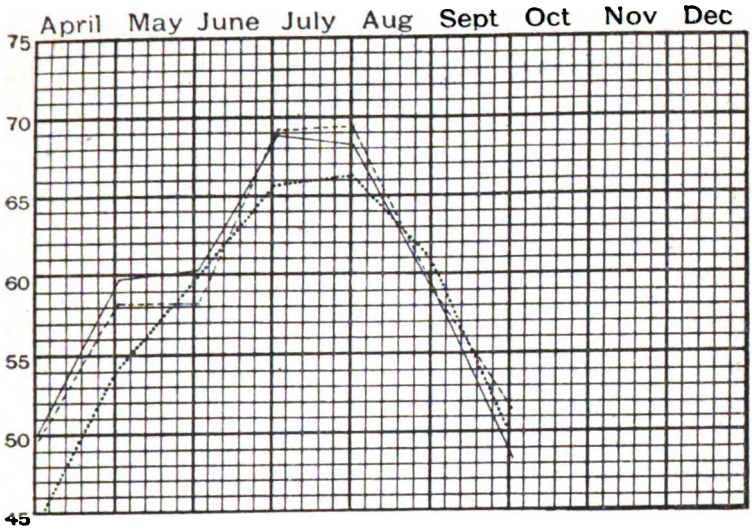
RESULTS.—Seed was sent to 140 farmers. twenty of whom reported absolute failure of crop on account of unfavorable weather, and two on account of insect pests and squirrels.

The average of all analyses for the state was 15.7 per cent sugar in the juice, with a purity of 78.08, against 13.75 per cent and a purity of 77.57 for previous season. Out of the 65 analyses made only 11 indicated less than 12 per cent sugar in the juice, and 41 samples indicated over 14 per cent, the extremes being 9.4 per cent and 23.8 per cent. The average for the different natural divisions of the state were as follows:

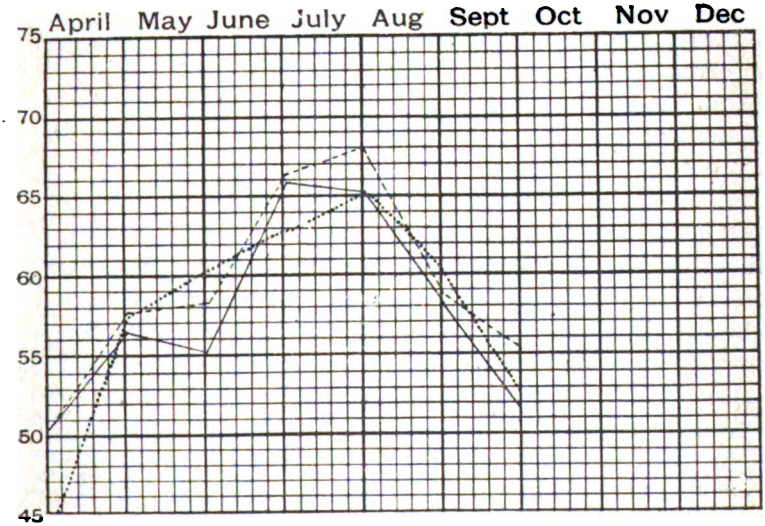
Willamette Valley, 44 samples.....14.7 per cent.
Eastern Oregon, 11 samples.....19.2 " "
Southern Oregon, 10 samples .....15.1 " "

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Comparative Temperature Charts.



Normal for Eastern Oregon ————
Mean for Eastern Oregon 1891 - - - - - -
Mean for Eastern Oregon 1892 .....



Normal for Willamette Valley ————
Mean for Willamette Valley, 1891 - - - - - -
Mean for Willamette Valley, 1892 .....

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Expressed by counties the averages are as follows:

TABLE IX

Showing Averages for 1892 by Counties.

County.	No. Analyses.	Average for 1892.	Purity.
Benton	17	12.80	86 50
Clackamas	1	15.10	87.83
Douglas	9	15.20	81.15
Jackson	1	15.00	84.74
Lane	2	15.20	84.05
Lincoln	3	16.20	83 00
Linn	1	17.10	73.74
Marion	2	13.80	74.60
Polk	5	14.50	73.30
Union	7	19.80	87.33
Washington	10	15 50	78.79
Yamhill	5	13.70	82.83
Josephine	2	15.70	88.00
Wasco	1	21.10	90.50
Malheur	1	20.20	84.90

The results of the different varieties of seed have been calculated only for the Willamette valley since in the other portions of the state there was not enough of any one kind used to give any valuable indications.

Vilmorin Improved.....13.4 per cent sugar.....76.2 purity.
Imperial Rose.....14.0 " " " .....84.7 "
Klein Wanzlebener.....15.0 " " " .....81.9 "
White Imperial.....15.9 " " " .....82.3 "

Experiments from 1893-1897.

While no definitely outlined experiments have been conducted since 1892, yet the Station has furnished more or less seed to various parties, who have sent the beets to be analyzed. In other cases beet seed has been furnished by other parties, and analyses have been made in all cases when beets were forwarded to the Station. The average of the results of 23 analyses made since 1892 shows 15.05 per cent sugar in the juice, and a purity of 89.8 per cent. In addition to these analyses, the following were also made, but the beets having received several rains before being sent, which had induced a second growth, and a number of the beets having been grown on alkali soil, the results were not taken into account in making up the averages.

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TABLE X.

Lab. No.	Grower.	Av. Weight Grams	Sugar in Juice.	Sugar in Beet.	Purity.	Solids.	Solids not Sugar.
780	W. G. Hunter	1997	13.6	12.93	70.5	19.3	5.7
779	L. Oldenburg..	1517	12.0	11.40	64.2	18.7	6 7
781	S. F. Newhard	717	5.0	4.75	57.7	8.8	3.8
782	C. A. Dunn.....	419	18.4	17.48	80.0	23.0	4.6
783	A. W. Gillis...	796	14.0	13.30	76.2	18.5	4.5
784	M. Reynolds...	225	10.0	9.50	66.7	16.5	6.5
785	W. A. Messner	474	20.9	19.85	82.5	25.2	4.3
786	A. Goodin.....	290	20.2	19.19	83.7	24.1	3.9
	Average.....	804	14.3	13.55	72.7	19.3	5.0

Average of all Results.

Let us now collect the results which have been thus separately set forth. In the same table I beg to include the averages from analyses made at Washington, D. C., by the U. S. Department of Agriculture. These last mentioned results really indicate a little too high, probably about 10 per cent, on account of the time that necessarily elapsed between harvesting and analyzing, which would result in a loss of water.

Expressed by counties the averages are as follows :

TABLE XI

Showing Average of all Analyses for each County.

County.	No. Analyses	Av. of Analyses made at Station.	Purity.	No. Analyses	Average for U. S. Dept. Agriculture.	Purity.
Benton.....	42	12.57	79.63	5	14.34	82.8
Clackamas.....	8	15.62	78.76	3	15.36	84.2
Columbia.....	1	13.74	79.42	3	15.30	81.7
Coos.....	0	.....	.....	5	14.56	82.6
Douglas..	18	14.10	77.98	1	17.74	84.3
Jackson	4	17.93	81.00	1	18.94	83.9
Lane.....	18	14.42	80.19	6	14.24	85.4
Lincoln*	....	.....	.....	..	.....	.....
Linn.....	6	14.13	73.43	1	14.15	79.4
Marion.....	4	15.17	74.60	2	14.15	81.1
Polk.....	16	14.54	74.10	1	12.10	79.8
Union.....	30	18.61	85.10	2	14.35	81.8
Washington.....	2	15.29	80.98	3	12.49	80.7
Yamhill.....	7	12.87	82.76	0	.....	.....
Josephine.....	2	15.70	81.21	0	.....	.....
Wasco.....	1	21.10	90.50	0	.....	.....
Malheur.....	1	20.20	83.44	0	.....	.....
Sherman	0	.....	.....	1	13.55	72.2
Umatilla.....	0	.....	.....	1	15.12	80.9
Multnomah.....	1	16.90	76.80	..	.....	.....

*Averaged with Benton County.

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If we omit, in making up the average for the state, those samples which indicate less than 10 per cent sugar in the juice (which were very few, as will be observed on examination of the table in the back part of the bulletin) as being beets which had not received proper cultivation, the averages for the state will be

	SUGAR.	PURITY.
For the season of 1891	14.3	78 2
For the season of 1892	15.9	81.4
Since 1892	15.0	84.8
Mean	15.0	81.5

TABLE XII

Showing Results of Varieties in Willamette Valley.

	Sugar.		Purity.	
	1891	1892	1891	1892
Klein Wanzlebener	14.3	15.0	79.0	81.9
Dippe Klein Wanzlebener	13.2	.....	77.1	.....
Vilmorin Improved	13.4	13.4	76.2	76.2
White Imperial	.....	15.9	.....	82.3
Desprez' Early Rose	.....	14.0	.....	84.7

Yield.

Attempts were made in these experiments to secure reliable data as to both the yield and cost as has been indicated above.

Altogether the reports for 1892 were quite complete. The results given are calculated from a measured plot according to the following instructions which were sent with each package of seed.

"When the beets seem to be mature select an average row and gather every plant along a distance which should vary as follows, according to width between rows:

From	rows	16	inches	apart	gather	75	feet.
"	"	18	"	"	"	66⅔	"
"	"	20	"	"	"	59.8	"
"	"	22	"	"	"	54¼	"
"	"	24	"	"	"	50	"

"The number of beets growing in the row, of the length mentioned above, must be counted. The tops are then to be removed, the beets carefully washed free from dirt, wiped and weighed. When the row is not long enough to meet the conditions, take enough from the adjacent row to make up the required length. The number of beets harvested multiplied by 435.6 will give the total number per acre. The total weight of beets harvested multiplied by 435.6 will give the yield per acre."*

Upon the above basis the reports on the following page were made.

*Circular of U. S. Department of Agriculture.

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J. S Powell....	Benton	15.8
College Farm.....	"	5.8
G. R. Woodruff	"	18.0
"	"	38.0
C. J. Bishop.....	"	23 8
William Bogue.....	"	15.1
Average.....		19.1
A. J. Thompson	Clackamas...	9.3
D. S. K. Buick.....	Douglas.....	25.0
W. L. Tower.....	"	8.2
B: D. Dyer	"	6.7
M. Lemmer.....	"	17.4
J. H. Bard.....	"	40.4
"	"	36.1
W. H. Norcross.....	"	17.4
Average...		21.6
Edward Albright.	Jackson.....	12.0
T. E. Hills.....	"	27.4
Average..		14.7
H. C. Perkins.....	Lane.....	18.0
J. H. Crow.....	"	9.5
R. S. Reed.....	"	22.8
R. E. Cartwright.....	"	30.2
Average.....		20.2
M. Snyder.....	Linn.....	11.7
W. E. Smith...	Malheur.....	20.2
J. Voorheees.....	Marion.....	21.5
J. W. Beatty.....	"	45.0
Average.....		33.2
A. W. Lucas.....	Polk.....	30.0
J. D. Stewart...	"	21.7
C. D. Nain.....	"	44.4
Average.....		32.0
M. J. Duffy.....	Union.....	5.0
J. E Reynolds.....	"	22.0
Aveage.....		13.5
J. H. Rinck....	Washington	17.0
"	"	10.0
John Henry	"	5.0
S. P. Reeder.....	"	14.0
J. D. Rowell.....	"	21.0
O. P. Pointer.....	"	8.
Average.....		12.6
M. O. Lownsdale...	Yamhill.....	47.0
J. H. Sample.....	"	6.8
Average.....		26.8
E. F. Meissner.....	Joseph ne.....	15.2

Segregating the results of 1892 from those of 1891, it is found that notwithstanding the unfavorable season the average yield for the state was 23.18 tons per acre against 20.5 tons for 1891.

The average yield reported in California in 1896 was 14 tons per acre. The following averages have been obtained in other states :

Minnesota.....	15.0	tons per acre.
Wyoming.....	7.5	" " "
South Dakota.....	8.1	" " "
Nevada	20.0	" " "
Colorado.....	26.0	" " "
Iowa.....	20.0	" " "
Indiana.....	30.0	" " "
New York.....	19.5	" " "

With the exception of California, the yields above given were obtained in experimental culture as in Oregon. That from California was based upon actual results obtained by farmers in producing beets for the factory. Other results obtained in the same manner are as follows :

TABLE XIII.

	1891	1892	1893	1894	1895
Lehi, Utah....	6.60	6.50	9.70	11.47	11.54
Chino, California.....	7.26	7.50	11.70	9.16	11.03

One striking feature in the above table is the increase in yield after the first two years—after farmers had become

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acquainted with methods of cultivation. To produce the highest yield, both in tons and in the per cent of sugar, requires a certain amount of skill, which has to be learned by careful observation and study, which fact is illustrated in the above table.

Mr. John Henry, of Beaverton, and Mr. R. Kuhne, of Tigardsville, Oregon, both undertook quite carefully conducted experiments during the past year. The former reports a yield of 10.5 tons per acre, which cost $42.89, not including delivery to the factory. Concerning the cost Mr. Henry writes:

"In this experiment the cost per acre of beets is far too high. I put the seed in with a hand instead of a horse drill, and dug with a spade instead of a horse puller.

"The fact which I sought was the cost between the time the seed was in the ground till the crop was ready to dig, with labor costing 10 and 12½ cts. per hour, and it was just $12.14. In the total is included

Preparing the acre	$5.00
Seed, 8¾ pounds	2.62
Interest on land	8 00.

"The ground had an ordinary plowing in March, and was plowed ten (10) inches deep, and seeded May 21st. Previous crop was corn, manured."

It should be stated that Mr. Henry's beets were excellent samples, analyzing 18.3 per cent sugar in the juice, with a purity of 86 7. For such beets as these a factory would pay about $5 per ton.

Mr. Kuhne's report showed a yield of 13 tons per acre, which cost $35. These beets would have commanded from $4.50 to $5.00, according to their sugar content which in all cases was high, and the purity exceptionally good, thus giving a return of about $60 per acre, or a profit of $25.

I consider these results quite trustworthy, and fairly indicative of what may be expected from careful, intelligent work. Mr. Henry is a very careful worker, and has had much experience in vegetable growing. Mr. Kuhne has had many years experience both in Germany and this country in growing beets for sugar purposes.

It is evident that, as with every other crop, the yield and cost of beets must necessarily depend upon many things, as variety, distance between rows, soil, cultivation, and season, hence this will always be a more or less varying factor. I think, however, that for the Willamette Valley and Southern Oregon in general, when farmers have become accustomed to the business, an average of 15 tons per acre is a very conservative estimate.

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In Eastern Oregon the uncertainty of the season renders the ability to irrigate almost an essential condition, and if this is met, there can be little doubt but that the yield would even exceed that for the Willamette Valley.

Turning elsewhere for additional information I offer the following from the Watsonville *Pajaronian* which gives a review of the cost and returns from sugar beet crops in the Pajaro valley during 1891. In explaining the results the writer says the results are taken from the cultivator's own figures. In each instance the land belonged to the beet grower, and his estimated value of the rent given. In the article mentioned there are given statements of ten growers of which we select the lowest, and the highest.

L. E. PEARCE—15 ACRES.

"Plowing and preparing land, $5 per acre—31 cents per ton—total $75. Seed, $1 02 cents per acre–6 cents per ton–total, $15.30. Hoeing, thinning, topping and loading into wagon, $24.23 per acre–$1.50 per, ton–total, $362.45. Plowing out and hauling, $8.08 per acre—50 cents per ton—total, $121.20. 241,147 tons yielded $1205.73; profit per acre, $42.05; per ton, $2.63; estimated rent of land, $15 per acre—93 cents per ton."

J. PEDERSEN—15 ACRES.

Plowing and preparing land, $7 per acre—30 cents per ton—total $105. Seed, $1.09 per acre—5 cents per ton—total, $16.35. Thinning, hoeing, topping and loading into wagon, $28.43 per acre—$1.20 per ton—total, $426.45. Plowing out and hauling, $9.48 per acre—40 cents per ton—total, $142.20. 350.17 tons yielded $1,750.86; profit per acre, $70.72; per ton, $3.05; estimated rent of land, $20 per acre—84 cents per ton.

I also present the statement of four growers near the Chino factory, which shows the cost to the time of harvesting.

STATEMENT OF F. MOORE.

Preparing soil, 20 acres	$58.75
Seed, 302 lbs, at 12 cents	36.24
Planting	13.00
Thinning	75.00
Hoeing	24.00
Cultivating	27.50
Total expense	$234 49
Expense per acre	11.72

STATEMENT OF W. C. RIGHTMIER.

Preparing soil, 17 acres	$68.90
Seed	20 40
Planting	6.80
Thinning	88.40
Hoeing	34.00
Cultivating	34.00
Total expense	$251.60
Expense per acre	14.80

STATEMENT OF BRENTTINGER & TIFFANY.

Preparing soil, 50 acres	$150.00
Seed, 15 lbs. per acre, at 12 cts.	90.00
Planting	20.00
Thinning	308.00
Cultivating	25.00
Hoeing	60 00
Total expense	$653.00
Expense per acre	13.06

STATEMENT OF MR. PRIMS.

Preparing soil, 10 acres	$25.00
Seed 108 pounds	12.96
Planting	4.50
Thinning	45.25
Hoeing	54.00
Cultivating	11.50
Total	$153.21
Expense per acre	15.32

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PART III.

Cultivation.

Too much cannot be said upon this subject. for *in the cultivation lies the secret of success in sugar beet culture.* It has been said, "The sugar is hoed into the beet," and this is literally true. The foregoing results were all obtained while the farmers were entirely unfamiliar with the careful culture so essential to success in this industry. The sugar beet is a thoroughbred, and needs close attention. When neglected it will show a double resentment by giving (1) a small sugar content and low purity, (2) a small yield. Small size, regular tapering roots, growing entirely below the ground are three essential points to be secured in beet culture. Whatever method of cultivation be followed, these three points should ever be the object. In many cases all three had been neglected in the cultivation of the beets above described, the directions to the contrary notwithstanding. This has undoubtedly had the effect of lowering the average for the state by at least one per cent.

I consider the beets produced by Mr. Henry and by Mr. Kuhne, before mentioned, as being the most indicative of what may be expected in Oregon, when growers understand the cultivation of beets for sugar purposes. Particularly do I think this is true of Mr. Kuhne's beets, for the gentleman for many years was connected with the Oxard factory in Nebraska as an expert grower of beet seed. These beets were received Oct. 1, and gave the following results:

TABLE XIV

Showing Analyses of Oregon Beets Produced by an Experienced Grower.

Lab. No.	Av. Wt. in grams.	Sugar in Juice.	Purity.	Variety.
748	275	17.0	91.4	Klein Wanzlebener (German Seed.)
749	337	16.6	89.2	Vilmorin, Blanche ameliore (Fr. ")
750	268	17.8	88.2	Kuhne's Improved (Nebraska ")
Av.	290	17.1	89.7	

The above samples had received the first rains. On Dec. 8, after the second heavy rain, beets from the same plats were again subjected to analysis.

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PLATE III A. SUGAR BEET FIELD.

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TABLE XV.

Lab. No.	Av. Wt. in Grams.	Sugar in Juice.	Purity.	Variety.
761	222	16.5	81.1	Klein Wanzlebener (German seed.)
762	198	14.0	77.7	" (Nebraska ")
759	329	15.4	93.0	Vilmorin Blanche ameliore (Fr. ")
760	.....	12.4	90.7	" " " (Nebraska ")
758	158	13.6	85.0	Kuhne's Improved (Nebraska ")
	236	15.2	86.3	Av. of same varieties as in table XIV.

Mr. Henry's beets gave the following results:

TABLE XVI

Showing Analyses of Well Cultivated Beets.

Lab. No.	Av. Wt. in Grams.	Sugar in Juice.	Purity.	Date Received	Variety.
732	281	18.3	86.7	Sept 22 96	White Imperial, German
756	279	18.8	92.1	Nov. 2, 96	" " "
757	279	16.1	71.2	Nov. 2, 96	Klein Wanzlebener
		17.1	83.3		Average.

When these results are compared with those of other states in which the cultivation has become reasonably good, I think it will be admitted that Oregon need stand second to no state in producing beets suitable for sugar purposes. Prof. Wiley in his notes on the analyses made at the U. S. Department of Agriculture, says: "The samples from Oregon are uniformly rich in quality, and if they truly represent the capabilities of the state, there is certainly a bright future for the sugar beet industry on that portion of the Pacific coast."

If we turn to either California or Utah, we will find evidence that in neither place did the farmers at first reap the greatest rewards, and this could not be expected in Oregon. In these two states there has been a progressing richness of the beet as better methods of cultivation were adopted, as instance:

TABLE XVII

Showing Effect of Improved Culture.

STATE.	1891	1892	1893	1894	1895
California, Chino.....	13.0	14.0	14.0	15.0	15.0
Utah, Lehi...	11.0	11.8	11.6	12.1	13.5

Not only has the sugar per cent increased, but also the yield per acre:

YEAR.....1891	1892	1893	1894	1895
Utah, tons.....6.60	6.50	9.70	11.47	11.57

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A small beet is desirable, for the sugar content and purity varies inversely as the size of the beet. The size of the beet can be largely governed by close planting, which not only gives a richer beet but also a greater yield. Pagnoul has conducted experiments extending over 8 years intending to show this.

DISTANCES APART IN INCHES.	PER CENT SUGAR.	YIELD PER ACRE.
Wide distance, 20 × 20	10.2	28.40
Narrow distance, 17 × 8	12.2	36.05

The same may be shown by the following Oregon produced beets, selected at random from the tables:

TABLE XVIII

Showing Quality of Small and of Large Beets.

SIZE.	VARIETY.	Weight in Grams.	Per cent Sugar in Juice.	Purity.
Small.	White Imperial	192	20.60	84.32
"	Klein Wanzlebener	341	19.00	67.80
"	White Imperial	250	16.70	88.30
"	Early Rose	165	17.70	76.60
"	Klein Wanzlebener	236	16.20	76.04
"	Vilmorin	350	18.00	82.13
Average		256	18.00	76.19
Medium.	White Imperial	538	14.70	71.80
"	Klein Wanzlebener	865	14.15	81.79
"	White Imperial	803	10.90	83.20
"	Desprez Early Rose	980	14.00	82.90
"	Klein Wanzlebener	920	15.99	78.38
"	Vilmorin	1021	13.40	54.10
Average		856	13.86	75.36
Large.	White Imperial	1623	14.00	74.20
"	Klein Wanzlebener	1880	14.41	80.55
"	White Imperial	1416	19.30	77.20
"	Desprez Early Rose	1970	11.90	85.00
"	Klein Wanzlebener	1700	12.88	80 00
"	Vilmorin	1700	9.81	68.12
Average		1715	13.71	77.51

Thus it is seen that the method of planting conducive to the production of beets rich in sugar, also gives the largest yield.

Good cultivation demands that the beet root be entirely below the ground. If above ground the sugar content decreases rapidly in the upper portion, which under any circumstances is the poorest in sugar which fact is well shown in the following tables:

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TABLE XIX

*Showing Effect of Good Cultivation.**

		Amt. of sugar	Purity.
Well grown, average of	top	15.5	82.7
	bottom	16.6	83.0
Poorly grown, average of	top	11.4	69.9
	bottom	13.6	77.2

Also from beets analyzed at the Station:

TABLE XX

Showing Relative Quality of Top and Bottom of Root.

	Sugar in Juice.	Purity.
Top of No. 782	17.0	76.6
Middle of No. 782	18.6	83.4
Bottom of No. 782	20.4	86.8

The matter of securing good beets rich in sugar, as well as a good yield, is almost entirely dependent upon careful cultivation. They cannot be produced on a large scale by any one person, nor in as careless a manner as most crops. The industry offers no inducement for the naturally tired farmer. The sugar beet requires much work, but when well cared for will give larger returns. There is no royal road to wealth even through the sweetness of the sugar beet.

The soil requires special preparation. The first plowing, which should be in the fall, should be followed by a spring plowing to a depth of not less than 10 inches, and almost without exception in Eastern Oregon and the Willamette Valley the ground should be sub-soiled to a depth of 15 inches. This I deem essential in portions of Oregon to prevent the beet from growing out of the ground. If the beet comes in contact with a hardpan, it is pushed directly upward by its own growth, and in most cases the root splits into several branching prongs, as illustrated in *Plate III.*

Allow to lie until about one week before the time for seeding. Then plow once more to a depth of 4 to 5 inches, and work the soil into a fine and *light* condition (i. e., do not pack it down with a drag.) After allowing land to lie 5 to 7 days plant the seed. The object of allowing the interim is that sufficient mois-

*Bulletin 67, Ontario Experiment Station, Guelph.

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ture may be drawn from below for the germination of the plant, and that the land may be warmed by the sun, after pulverization. No manure should be applied unless in the shape of well-rotted compost put on in the fall. In ordinary soil the rows should be eighteen inches apart: in very rich less; and in poor soil more than that distance apart. The conditions should be such that the beets can not attain a greater weight than two pounds each. The seed should be planted one-half to three-quarters of an inch deep, and about 20 pounds of seed used to the acre. The seed may be soaked before planting, which should be done as early in April as the conditions will allow.

The cultivation must be thorough, and should begin as soon as the plants show in the row. When the beets have put out four leaves thin them out so as to leave the plants standing about six inches (not farther) apart in the row. The weeds should be kept down and the ground well stirred.

Several special tools have been devised for the cultivation of the crop, a description of which can be found in the publications of the U. S. Department of Agriculture. These, however, will only be needed in case the industry should attain a footing which demands a large supply of beets. As soon as the beets begin to to show any tendency to grow out of the ground, earth should be well ridged up along the rows to cover the upper part of the beets.

The beets should not be harvested till perfectly ripe, which will be indicated by a yellowish green color of the outer leaves, which fall and form a wreath around the plant.

Just what will be found the *best* method of keeping beets after they are ripe, till they can be used at the factory, cannot be answered at present with any degree of certainty It may be found possible in Eastern and Southern Oregon to leave the beets in the ground till needed at the factory. This would be possible if it is found that the slight second growth which might be induced would not cause a greater loss of sugar than would be occasioned by siloing. If this method can be practiced it means a material saving in handling the crop. If the loss by such a method is too great, then either the silo, consisting of a pit lined with straw, or sheds, as used at Norfolk, Neb., shown in the accompanying illustration, which also well illustrates the magnitude of the industry as there operated, may be used. Either of these

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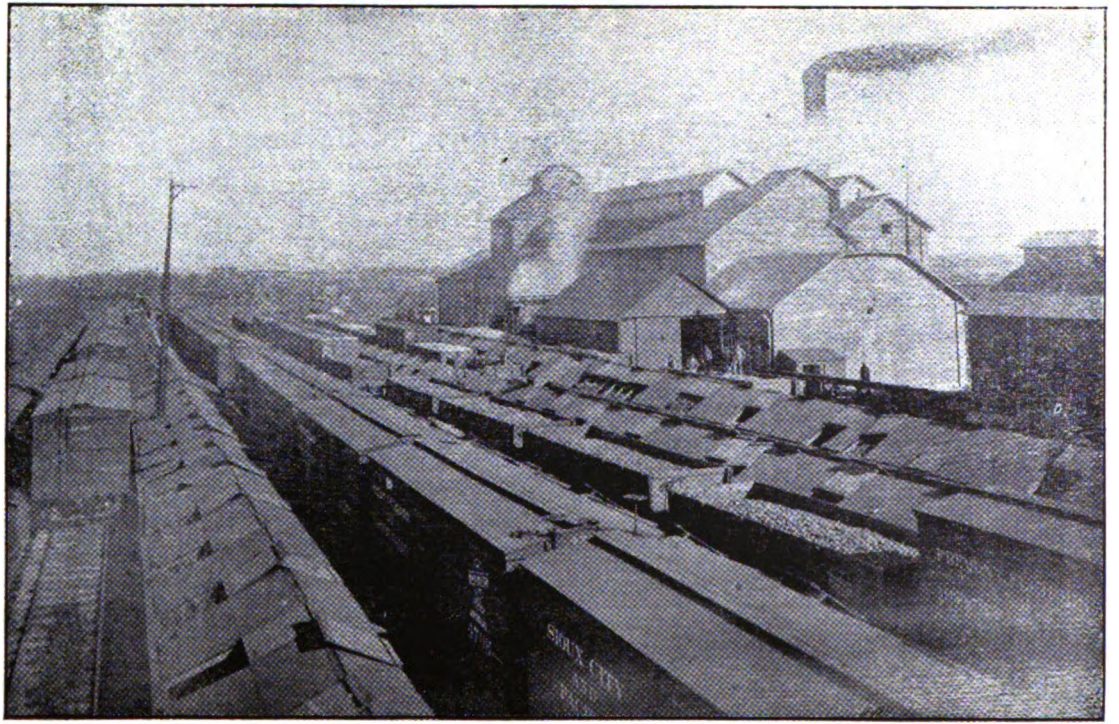


PLATE III B. EXTERIOR OF BEET SUGAR FACTORY, NORFOLK, NEBRASKA.

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methods, I am satisfied can be used successfully in the eastern or southern part of the state, but in the Willamette Valley probably the shed will be the only feasible means. Experiments are to be made this season to determine the rate of decrease in sugar content and purity by allowing the beets to remain in the ground till used.

The producing of beets rich in sugar is an important matter from a financial standpoint, for it costs nearly as much to produce beets containing the minimum of 12 per cent sugar, as to produce those carrying 18 per cent. The former would bring but $3.50 per ton, or, assuming a yield of 12 tons per acre, an income of $42 per acre, while the latter would bring $4.50 per ton, or $54 per acre, which is a very material difference.

The growing of beets is particularly adapted to small farms, and offers remunerative employment to nearly the whole family. Much of the work can be done by the children, thus giving fair returns for their labor. as well as the profit on the crop.

Further the industry is bound to show results in a better system of general farming, for it will induce careful attention to the best practice in order to obtain the optimum results. He who produces the best quality of beets will obtain the best price for his product. Hence the industry will be an educational one in the truest sense.

Beets Instead of Bare Fallow.

If farmers undertake sugar beet growing the crop should be one of rotation. This could well be substituted for the bare fallow, to which wasteful practice so many farmers in this state are wedded.

It has been found both in Europe and in this country that it is much more profitable, as well as better for the land, to raise a crop of beets than to allow the ground to lie fallow. Instead of substituting beets for some other crop they should be made supplemental to those at present available. No farmer should think of giving up cereals or potatoes for beets; but he can, by proper culivation, devote one-fifth of his land to beet culture and raise as much from the remainder as though none of the land was occupied by beets. There is no crop which could better fall into a rotation suitable to Oregon than sugar beets. In California it has been found a most excellent crop to precede barley, giving both a better yield of grain and a better quality.

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In this connection let us use the words of Mr. E. H. Dyer, taken from a circular sent in 1885 to the members of congress. In relation to establishing the industry in California, he says:

"One of the greatest obstacles we had to contend with, was to induce the farmers of California to cultivate beets in a manner to be profitable to manufacture into sugar. We had to convince them that beets properly raised for sugar were not exhaustive to the soil. We have, at this time, overcome most of the farmers' prejudices, and now have no difficulty in obtaining an abundant supply of beets, cultivated properly for sugar. Our farmers have ascertained by actual experience, that beets are very desirable to rotate with other crops; cereals raised on land planted to beets the preceding year give large returns."

This is the more true since the beet is not exhaustive to the soil, and the richer the beet in sugar the truer is the above statement. The sugar is produced by a combination of carbon dioxid from the air with water, and investigation shows that the salts of the beet are inversely proportional to the sugar. The part of the beet which removes the largest amount of mineral matter, i. e., the leaves and crown, is either returned to the soil directly, or indirectly by being fed to stock.

Enemies.

It is not proposed to discuss this subject at length in this Bulletin. There were but few pests reported as troubling the sugar beet. The most to be feared is perhaps, *Monoxia guttulata*, (Lec.) as reported by Prof. F. L. Washburn, and described in Bulletin No. 14, of this Station.

There was also sent to this Station, and referred to the Entomologist, another insect which was said to be troubling the beets raised in Clackamas county. This pest, known as the "flea beetle"--*Phyllotreta decipiens* (Horn), belonging to the family *Chrysomelidae*, is about ⅛ inch long, and of a black color. With other members of the same family, it has the femurs of the hind pair of legs strongly developed, and when alarmed jumps with so much alacrity that it is difficult to catch, hence the popular name of the family. They are found on radishes, turnips, potato vines, etc. It is not likely that they are a serious enemy of the sugar beet.

The "cut worms" were also reported to have caused considerable damage to the beet in Central Oregon. In fact, they were reported as having in some instances destroyed the entire crop.

Gophers also caused some trouble in Benton county, and are said to have shown a decided preference for the sugar beets.

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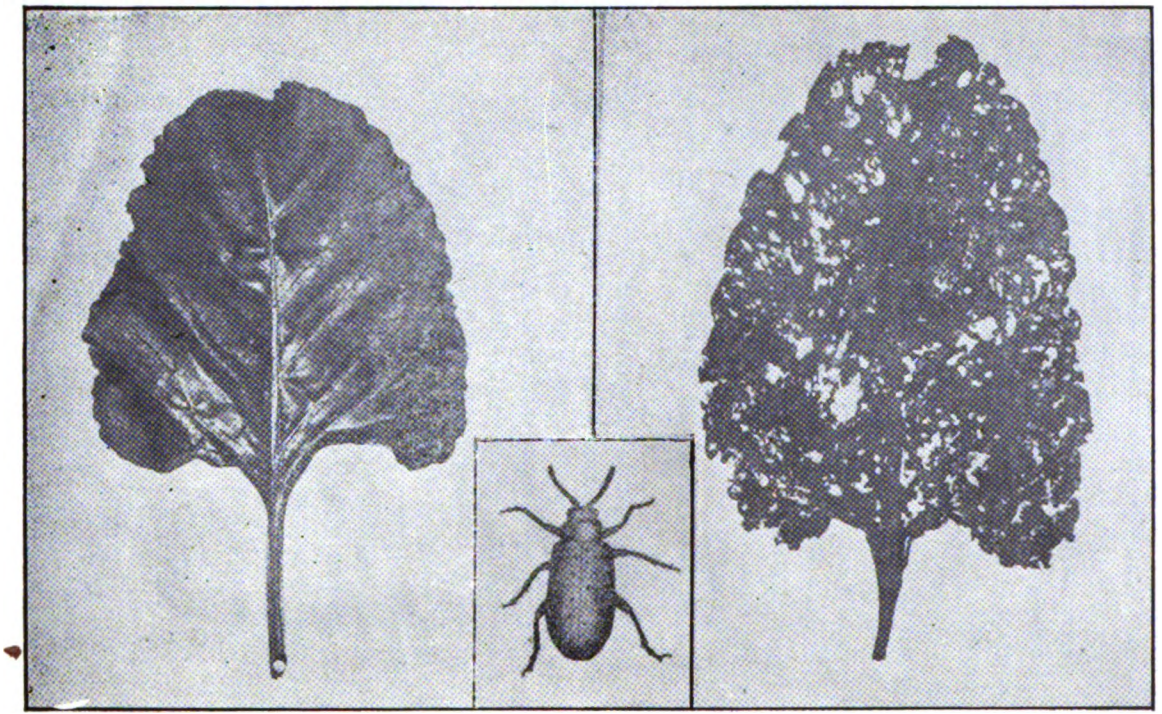


PLATE IV. *MONONIA GUTTULATA* AND ITS WORK.

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PART IV.

The Factory.

One of the most frequent questions asked is concerning the location and cost of a sugar factory, hence I deem it advisable to present here such information as can be given briefly.

Before considering the cost it is well to determine whether or not all the requisites can be furnished, for the cost will be governed by these considerations.

The first requisite is *an abundant supply of pure cool water*, which is absolutely indispensable. A factory of 300 tons capacity uses daily no less than 1,000,000 gallons of water.

Second, there must be *an adequate supply of fuel*, which can be had at a reasonable cost. The cost of fuel at other places is given elsewhere in this Bulletin. A factory of the above named capacity would use about 100 tons of coal, or its equivalent per day.

Third, *good transportation facilities* are essential, hence, other things being equal, it is best to locate where both river and railroad transportation can be secured, and usually near some center of population, although the latter is not absolutely essential.

Fourth, *there must be an available supply of suitable limestone*, of which about 3 car loads per day are used. It ordinarily requires a ton of lime to each ton of purified sugar.

Fifth, *the enterprise requires a large capital* to erect buildings, purchase expensive machinery and secure skilled labor. It is often asked if a factory could not be started on a small scale by the coöperation of a few farmers. Suffice it to say that experience has amply demonstrated this to be entirely impracticable. The average capital invested in a factory using 350 tons of beets per day is about $500,000. Such a factory would expect to run 125 to 150 days which period is called the campaign. To carry on the work of such a factory about 200 men would be required, of which the following must necessarily be skilled labor, a superintendent, and an assistant, ten employes skilled in diffusion, etc., a chemist, and a machinist. These would be sufficient for train-

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ing others in the business.

Dr. Wiley, chief of the Division of Chemistry, Department of Agriculture, in Bulletin 27, says:

"The cost of a beet sugar factory depends on so many conditions that it will be impracticable to give anything more than a rough estimate of it. Much depends on the character of the building itself, and this, for various reasons, should be made fire-proof, thus entailing the constructon of a building of considerable cost. In regard to both the building and the machinery, the total cost will depend largely on the capacity of the house; the cost, however, does not increase in the same ratio as the capacity. In other words it may be stated that the cost of a beet sugar factory capable of working 400 tons of beets per day would not be double the cost of one working 200 tons. A beet sugar house based on an estimate of 300 tons per day would probably be more in keepin with the character of the houses that which are to be built in this country for sometime to come than any other. With a proper fire-proof building, and the best and latest machinery, such a factory would cost, ready for work, from $150,000 to $200,000. Factories, of counse, can be built at much less cost than this, but doubtless at the sacrifice of efficiency in some of its parts, so that true economy would advocate the construction of a high priced factory of the best workmanship and of the most approved style."

Mr. M. Swenson, of the Walburn-Swenson Company, of Chicago, manufacturers of sugar machinery, writes to the Wisconsin station as follows:

"The cost of the machinery complete in every particular for a beet sugar factory having a capacity of from 300 to 350 tons of beets per day, including all pumps for water supply, boilers, engines, etc., the whole to be of the very best design and workmanship, and capable of making white sugar direct from the beets, without any refining would be in the neighborhood of $170,000 on cars in Chicago. The machinery for a factory having double this capacity would cost about $260,000.

"These prices you will of course understand are somewhat approximate as prices vary very much.

"The cost of a first-class brick building, including boiler house for the smaller sized factory, would be from forty to fifty thousand dollars. This would also include foundations, lime kilns, etc. Just what the cost of the sheds for holding the beets would be I cannot say, but I am of the opinion that four or five thousand dollars would be suficient to cover this item. All the castings, etc., for the lime kilns are included in the price of the machinery, and the brick work would be easily within the above cost of buildings.

"A building for the larger plant would probably cost $75,000 if put up in every way first-class.

"There is no doubt but there is much misconception as to the cost of a factory of this kind, and many people write us thinking that with an old building and a second-hand boiler and engine that has been used for some other purpose, they have a good nucleus for a beet sugar factory, and that for twenty or thirty thousand dollars it can be all fitted up. Any attempt of this kind is simply throwing money away, and it would be a great misfortune to the beet sugar business to have it gone into without sufficient capital to erect a factory of proper size, as well as of the most modern construction."

A sixth requisite for a factory is *an unfailing supply of beets.* To supply the demands of a factory of 300 tons of beets per day

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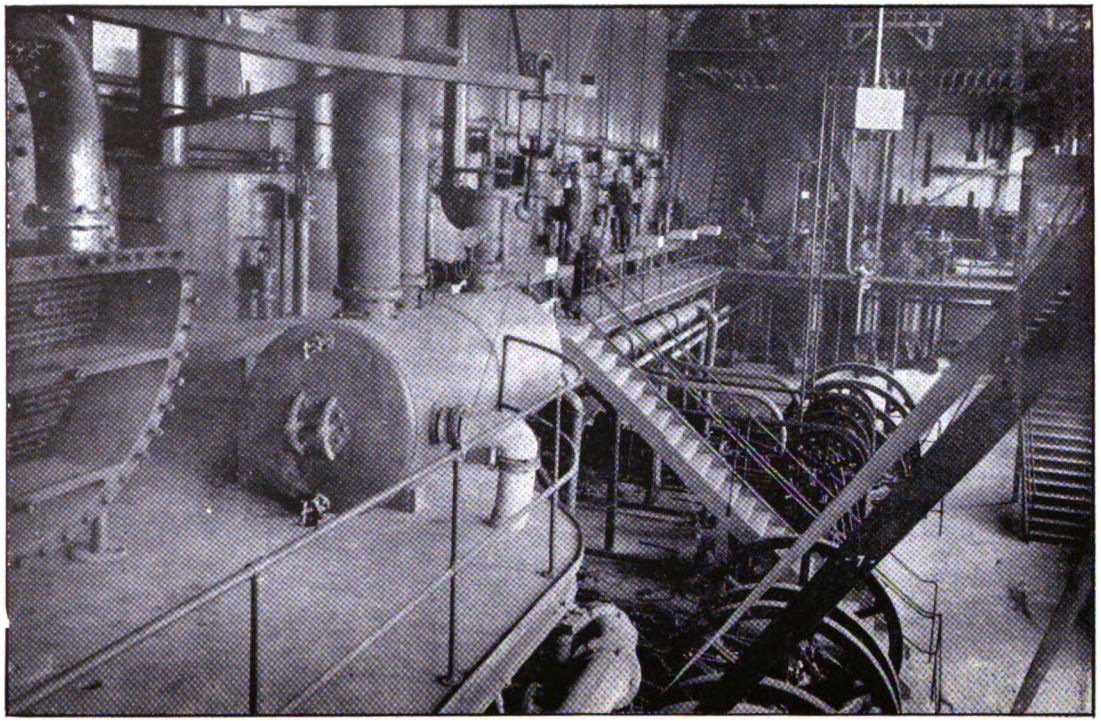


PLATE V. INTERIOR OF BEET SUGAR FACTORY, NORFOLK, NEBRASKA.

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would require about 3000 acres of land each year. Since beets should not be produced two consecutive years upon the same soil 6000 acres of beet land must be available.

THE MANUFACTURE OF SUGAR.—The campaign in countries where early frosts interfere is of about 100 days duration, but in Oregon it could be extended to 150 days, or even longer, by storing the beets as before described. A detailed description of the process of sugar munufacture would not be in place in this publication, hence only a short resume is inserted.

The beets, after leaving the storage bins or pits, are thrown into canals, and by machinery washed free from dirt. By revolving knives they are cut into thin slices or "cosettes," which are macerated in water, in this process passing through a battery of several cells, known as juice stations, which remove all the sugar. The juice is now passed to a cooling reservoir, after which it is purified by means of lime, carbonic acid and filter process. The purified juice is now evaporated in vacuum pans to a kind of sugar containing about 6 per cent of water. This is known as "masse cuite." This is passed to a centrifugal machine, or granulator, where it is dried and sifted into a hopper, from which it is drawn into barrels or sacks ready for the market as granulated white sugar. The syrup is reboiled and again passed through the granulator. The chips are used for cattle food, the press cakes and other refuse are used for fertilizing purposes, and the waste syrup used for the manufacture of alcohol. When beets are sound it takes about 15 hours to convert them into granulated sugar. If they are frozen it takes a little longer.

The manufacturer has practically all the risk to run, unless he can actually be assured of a sufficient supply of beets. If he cannot be thus assured, of course we will have no factory, for no man or combination of men would invest much capital in an enterprise which would be entirely at the caprice of the farmers. The question as to whether or not farmers should grow beets depends upon whether or not factories are established to use the beets, and *vice versa*, hence it is a question of double issue and can only be solved by coöperation. It is a lamentable fact—yet no less a fact—that the farmer looks upon the manufacturer as one who is, at all times and under all circumstances, trying to get the better of him, and this serves as a great barrier to success in

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the production of beet sugar. In this industry, as in no other, are the producer and the manufacturer linked hand in hand, and what is money in the pocket of one is also money in the pocket of the other. It matters not how well equipped and manned a factory is unless it is amply supplied with beets it is doomed to failure. In Nebraska two factories existed several years before farmers supplied beets sufficient for a profitable campaign.

If Oregon enters the arena, it must be with the most modern appliances. If this cannot be done we would best not undertake the enterprise. It is best to go slow but sure in a matter of so great moment, for a failure from lack of beet supply would be a serious blow to future work. Let farmers coöperate in thoroughly investigating and satisfying themselves as to the cost of producing good beets. The Station stands ready to determine the quality of the beets, free of cost, and to publish the results, provided the experiments are conducted in accordance with our directions. Let meetings be called and definite work be planned. For determining the cost of cultivation ordinary seed may be used, and the crop can be utilized as feed for cattle. Each farmer who enters upon the experiment should plant several rows of genuine sugar beet seed in order to determine the quality of the beets he is able to produce. This seed cannot be had of the regular seed dealers, but must be obtained from some of the factories. The Station will furnish directions for cultivation free of cost, or they will be found in this bulletin.

It is of little use for a few farmers in each county to plant a few rods of beets. The work should be done on a larger scale, and undertaken as a business proposition, in order that very tangible results may be secured as a basis for future work. It is already demonstrated that Oregon can produce beets rich enough in sugar, but it is not yet proven that she can produce them in sufficient quantities to supply the needs of a sugar factory. Co-operation of farmers is needed for this work from now on, and it is hoped that various farmers' organizations will take hold of the matter in a determined and systematic manner. It is a matter of supreme importance to the farmers of the state, particularly in Southern and Eastern Oregon. Will the farmers organize for the work? We shall be glad to advise with any organization having the above object in view.

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Resume.

The development of the beet as a sugar producing plant dates from 1847. It now yields from 15 to 20 per cent sugar and furnishes about one-half of the world's sugar supply. The early history of beet sugar manufacture in this country was marked by several failures, but for several years past factories have been operated successfully in California, Nebraska and Utah. Factories have also been erected in Wisconsin, New Mexico, and New York.

A good sugar beet should weigh about 1¾ lbs., should contain about 14 per cent sugar, and should have a purity of 80 per cent.

Systematic experiments in sugar beet culture were conducted during the years 1890—1892 to ascertain if Oregon could produce such beets.

Oregon is in the sugar beet belt. In the matter of climate the state is well suited to the conditions demanded by the sugar beet. (See map on page 14, and temperature charts pages 13 and 23.)

The apparent difference in rainfall from that of foreign areas should not be considered a too serious drawback, for the *seasonal precipitation in the Northwest, as in California*, is the influencing factor in crop production. When thus considered the precipitation compares well with areas now successfully producing beets for sugar purposes.

Any good wheat soil is a good beet soil, but beets are most grateful for a deep sandy loam. Oregon soils are abundantly supplied with phosphoric acid, the indispensable element for successful beet production, which fact is likely to bring the beets to an early maturity.

In the experiments the standard varieties of seed were used. In the experiment of 1891 it was impossible to plant seed till May, while ordinarily it can be done early in April. The beets did not receive as good cultivation as was desired.

In 1891, of the 95 analyses made, only 8 fell below 10 per

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cent, 76 showed over 12 per cent and 37 over 14 per cent sugar in the juice. For the entire state the average sugar content was 14.13 with a purity of 78.08. The average reported yield was 20 5 tons per acre.

Of the three varieties, original Klein Wanzlebener, Dippe Klein Wanzlebener, and Vilmorin, the first gave the best results.

The experiments of 1892 were handicapped by a "very dry" and unfavorable season. The average of all analyses for the state was 15.7 per cent sugar in the juice and a purity of 78.08.

Of 65 analyses made 41 showed over 14 per cent, and 11 showed less than 12 per cent. The range was from 9.4 to 23.8, but most of those running below 12 per cent were immature beets. Forty-four samples from the Willamette Valley showed 14.7 per cent sugar in juice; 10 samples from Southern Oregon showed 15.1, and 11 samples from Eastern Oregon, 19.2. White Imperial variety gave the best results, being above Klein Wanzlebener, Imperial Rose, and Vilmorin in the order named. The average reported yield was 23.18 tons per acre.

The average of the results of 20 analyses made since 1892 is 14.9 per cent sugar in juice with a purity of 89.8. Discarding poorly cultivated beets the mean of all analyses for the above three periods is 15 per cent sugar in the juice and 83.1 per cent purity.

Of the varieties previously mentioned White Imperial and original Klein Wanzlebener have given the best results in the order named.

Experience elsewhere shows that the highest results are not obtained by farmers at first, but that both the sugar content of the beet and the yield increase as farmers become more careful in the culture.

The cost o cultivation in Oregon will not be far from $35 per acre. Twelve tons per acre is a very conservatively estimated yield.

The sugar beet is a thoroughbred, and demands very careful cultivation. The sugar is hoed into it.

The sugar and purity are both lowered by a second growth. Three samples eets grown by an experienced grower gave 17.1 per cent sugar, and 89.7 per cent purity on Oct. 1. On Dec. 8, after the second heavy rain beets from the same plats analyzed

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15.2 per cent sugar, and 86.3 purity.

A small beet, with the root grown entirely beneath the soil, is demanded. This can be had by close planting and proper cultivation. The method conducive to the production of the most sugar also gives the largest yield in tons. The matter of securing good beets rich in sugar is almost entirely dependent upon careful cultivation.

Soil for beets should be thoroughly pulverized and sub-soiled to a depth of 15 inches. Seed should be soaked in urine and water before planting, which should be done in April. Keep absolutely free from weeds, and the soil well ridged up along the the rows of beets.

The growing of beets is particularly adapted to small farms, offering employment for the whole family.

The beet crop should be one of rotation, and should replace the bare fallow as it is better for the land.

A factory would cost about $200,000. The requisites are an abundant supply of water, fuel, and limestone, good transportation facilities, and an unfailing supply of beets.

If Oregon engages in the business, and hopes to succeed, it must be with the most modern appliances.

It is already demonstrated that Oregon can produce beets sufficiently rich in sugar, and with an exceptional purity. The question now before the farmer is, can he produce them in sufficient quantity and at a sufficiently low price. Coöperation of farmers is urged to settle this question.

The Station offers to direct the work, analyze all beets and publish results free of cost.

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Table XXI

Showing Analyses of Sugar Beets, 1891-1896.

	GROWER.	LOCALITY. POST OFFICE AND COUNTY.	SUGAR. Weight in Grams.	Sugar in Juice.	Sugar in Beet.	Solids not Sugar.	Brix.	Purity.	Pounds Sugar Per Ton.	VARIETY OF BEETS.
1	Ewd. Albright	Ashland, Jackson	244	14.00	13.1	5.3	19.3	72.53	280.0	Klein Wanzlebener.
2	A. W. Lucas	Monmouth, Polk	624	14.72	13.3	4.2	18.8	78.08	294.4	" "
3	D. S. K. Buick	Roseburg, Douglas	1700	9.81	9.3	4.6	14.4	68.12	196.2	" "
4	"	" "	1140	10.07	9.1	3.9	14.0	71.21	201.4	Vilmorin Improved.
5	J. Voorhees	Woodburn, Marion	920	15 99	14.6	4.4	20.4	78.38	319.8	Klein Wanzelebener.
6	H. C. Perkins	Llewellyn, Lane	739	17.06	16.0	4.3	21.3	80.09	341.2	" "
7	"	" "	900	14.96	12.7	5.3	20.3	69.26	299.2	" "
8	L. F. Wilson	Corvallis, Benton	389	13.46	10.9	6.3	19.8	66.36	269.2	Unknown.
9	College Farm	" "	375	13.28	12.0	4.4	16.4	80.97	265.6	Vilmorin.
10	H. C. Perkins	Llewellyn, Lane	1200	17.70	16.1	4.3	22.0	80.45	354.0	Klein Wanzlebener.
11	College Farm	Corvallis, Benton	355	12.03	11.4	3.1	15.2	79.91	240.6	Lane's Imperial.
12	" "	" "	250	12 39	11.6	2.5	14.9	83.15	247.8	" "
13	" "	" "	330	14.63	12.7	2.7	17.3	84.57	292.6	Klein Wanzlebener.
14	" "	" "	216	14.02	12.6	2.8	16.8	83.45	280.4	" "
15	" "	" "	208	16.35	14.0	3.5	19.8	82.56	327.0	Dippe Klein Wanzlebener.
16	" "	" "	212	13.50	11.9	4.5	17.0	75.41	270.0	" " "
17	J. S Powell	Philomath, "	384	13 60	12.4	3.8	16 9	76.80	261.6	Vilmorin Improved.
18	"	" "	388	11.36	10.8	5.2	16.6	78.48	227.2	" "
19	"	" "	465	11.97	10.8	5.0	17.0	70.45	239 4	" "
20	"	" "	594	13.07	11.8	5.1	18.2	65 06	261.4	" "
21	C. J. Bishop	Tidewater, Lincoln	397	14.46	13.7	5.1	19.6	73.77	2°9.2	" "
22	College Farm	Corvallis, Benton	185	12.86	11.5	3.0	15.9	80.88	257.2	Dippe Klein Wanzlebener.
23	" "	" "	255	12.51	11.3	3.3	15.9	78.61	250.2	Klein anzlebener.
24	" "	" "	200	9.73	9.0	2.5	12.3	79.10	194.6	Lane's Imperial.
25	" "	" "	200	13.00	11.9	2.9	15.9	81.76	260.0	Vilmorin Improved.
26	" "	" "	780	12.88	11.5	3.7	16.6	77.59	257.6	Klein Wanzlebener
27	" "	" "	642	12.05	11.0	4.7	16.8	71.78	241.0	Vilmorin Improved.
28	J. D. Wilson	Yoncalla, Douglas	348	14.75	14.0	3.8	18.5	79 72	29?.5	" "
29	"	" "	496	14.32	13.3	6.0	20 4	70.16	2?6.4	" "
30	A. R. Shipley	Oswego, Clackamas	.....	12.00	10.9	3.1	15.1	79 47	240.0	Dippe Klein Wanzlebener.
31	"	" "	945	12 71	11.8	4.6	17.4	73.04	254.2	" " "
32	John Rickard	Corvallis, Benton	1100	9.81	8.4	5.1	15 0	65.40	167.0	Klein Wanzlebener.

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33	John Rickard	Corvallis, Benton	700	6.76	6.0	4.7	11.5	58.76	135.2	Vilmorin.
34	"	" "	650	8.16	7.0	3.4	12.6	64.92	163.2	"
35	I. N. Sanders	Union Union	350	18.07	16.6	4.9	22.0	82.13	361.4	"
36	"	" "	475	15.52	14.4	3.7	19.3	80.04	210.4	"
37	C. L. Gowell	Toledo, Lincoln	205	17.29	16.1	4.0	21.3	80.37	345.8	Klein Wanzlebener.
38	P. Cooper	Roseburg, Douglas	1150	13.42	11.5	2.8	16.3	76.19	278.4	Vilmorin Improved.
39	B. F. Collins	Fir, Washington	375	9.95	9.4	2.6	12.6	78.96	199.0	" "
40	G. W. Mitchell	Newberg, Yamhill	975	10.73	9.8	3.2	14.0	76.64	214.6	Klein Wanzlebener.
41	B. F. Collins	Fir, Washington	1145	12.17	11.38	3.2	15.4	78.90	243.4	" "
42	G. W. Mitchell	Newberg, Yamhill	1115	11.64	10.52	4.5	16.1	72.29	232.8	" "
43	J. C. Johnson	Scapoose, Columbia	465	13.74	13.14	3.6	17.3	79.42	274.8	Vilmorin.
44	J. H. Rinck	Buxton, Washington	225	15.61	14.58	4.2	19.8	78.83	312.2	Klein Wanzlebener.
45	W. H. Smith	Roseburg, Douglas	665	10.34	9.12	2.0	12.3	84.64	406.8	Unknown.
46	H. Marks	" "	1230	10.80	10.26	4.2	15.0	72.09	261.0	"
47	John Withers	Lebanon, Linn	187	12.93	11.62	2.6	15.7	82.23	258.6	Vilmorin Improved.
48	John Henry	Beaverton, Washington	480	14.38	12.62	1.8	16.2	88.70	287.6	Redtop.
49	"	" "	340	13.02	12.14	5.1	18.2	71.53	260.4	Klein Wanzlebener.
50	College Farm	Corvallis, Benton	475	13.36	12.06	3.4	16.8	71.78	267.2	Vilmorin.
51	" "	" "	509	12.51	11.91	3.1	15.7	79.61	250.2	Klein Wanzlebener.
52	" "	" "	283	12.05	11.52	4.8	16.9	71.30	241.0	Dippe Klein Wanzlebener.
53	" "	" "	170	12.12	11.10	3.9	16.0	75.75	242.4	" "
54	" "	" "	155	12.82	11.68	3.8	16.7	76.75	256.4	Lane's Imperial.
55	" "	" "	225	12.42	11.18	3.4	15.9	78.11	248.4	Vilmorin.
56	Samuel Howard	Eugene, Lane	1300	13.00	11.97	3.9	17.0	76.47	260.0	Unknown.
57	"	" "	1018	11.30	9.81	4.1	15.4	73.37	226.0	"
58	R. Scott	Milwaukee, Clackamas	1213	12.82	12.91	2.88	16.8	82.26	276.4	Klein Wanzlebener.
59	"	" "	200	12.18	11.66	4.2	16.4	74.26	243.6	" "
60	T. Pavey	Yaquina, Lincoln	850	16.23	14.43	2.6	18.9	85.82	224.6	Unknown.
61	E Terpenning	Eugene, Lane	865	14.15	13.76	3.1	17.3	81.79	183.0	Klein Wanzlebener.
62	"	" "	1880	14.41	13.58	3.3	18.0	80.55	288.2	" "
63	"	" "	550	15.18	13.74	1.9	17.0	89.29	303.6	" "
64	M. H. Harlow	" "	1700	12.88	12.38	3.2	16.1	80.00	757.6	" "
65	"	" "	930	15.36	14.20	2.8	18.2	84.39	307.2	" "
66	"	" "	340	17.61	15.74	2.0	19.6	89.84	352.2	" "
67	"	" "	575	14.82	13.09	2.7	17.6	84.20	296.4	" "
68	W. W. Crow	Lorane, Lane	682	11.30	10.22	4.7	16.0	76.62	226.0	Dippe Klein Wanzlebener.
69	J. H. Crow	" "	215	15.69	14.23	2.7	18.4	90.70	313.8	" "
70	C. J. Bishop	Tidewater, Lincoln	875	13.42	12.24	3.3	16.8	79.88	268.4	Klein Wanzlebener.
71	W. R. Wise	Newbridge, Union	1150	13.95	12.67	4.1	18.0	77.50	279.0	" "
72	J. H. Rosebrook	Toledo, Lincoln	450	13.68	12.16	4.7	18.4	74.36	273.6	Dippe Klein Wanzlebener.
73	"	" "	460	13.42	11.92	3.8	17.3	77.57	268.0	Unknown.
74	C. J. Bishop	Tidewater, Lincoln	927	14.68	13.95	3.9	18.6	78.82	293.6	Vilmorin.
75	John Gage	Stafford, Clackamas	720	16.05	15.07	5.3	22.4	71.65	321.0	Klein Wanzlebener.
76	"	" "	875	13.42	12.14	4.7	18.2	73.73	268.4	" "
77	C. J. Bishop	Tidewater, Lincoln	412	15.57	14.85	2.4	18.0	86.00	311.4	Bulteau Desprez.
78	"	" "	405	14.17	13.12	2.3	16.6	84.75	283.4	" "
79	James Wilkinson	Beaver Creek, Lincoln	1075	12.55	11.59	4.6	17.3	72.54	251.0	Unknown.
8	Albert Brown	Philomath, Benton	825	12.03	11.23	4.3	16.4	73.35	240.6	"

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Table XXI (Continued)
Showing Analyses of Sugar Beets, 1891-1896.

	GROWER.	LOCALITY. POST OFFICE AND COUNTY.	SUGAR. Weight in Grams.	Sugar in Juice.	Sugar in Beet.	Solids not Sugar	Brix.	Purity.	Pounds Sugar per Ton.	VARIETY OF BEET.
81	J. H. Rinck	Buxton, Washington	305	15.71	14.38	6.2	20.0	71.40	314.2	Klein Wanzlebener.
82	"	" "	250	18.80	16.09	3.0	10.9	89.94	376.0	" "
83	Edward Albright	Ashland, Jackson	325	20.56	16.30	3.1	24.7	87.21	411.2	" "
84	"	" "	255	22.24	20.99	3.2	25.5	79.88	287.6	" "
85	G. H. Baber	Forest Grove, Washington	830	14.38	13.08	3.6	18.0	76.94	292.4	Unknown.
86	J. G. Stevenson	Eugene, Lane	495	14.62	13.25	4.3	19.0	77.30	151.4	Vilmorin Improved.
87	"	" "	475	7.57	5.88	5.3	12.9	70 87	226.8	" "
88	J B. Riddle	Riddle, Douglas	865	11.34	10 48	4.6	16.0	68.04	241.0	Klein Wanzlebener.
89	"	" "	1010	12.05	11.93	4.6	17.7	83.01	380.0	" "
90	W. E. Smith	Vale, Malheur	350	19.00	17.69	2.8	22.9	81.98	272.2	" "
91	O. P. Coshow	Brownsville, Linn	450	13.61	11.58	3.0	16.6	72.16	226.6	Unknown.
92	"	" "	950	11.33	10.53	4.3	15.7	72.16	397.4	"
93	"	" "	750	9.87	8.48	1.7	11.6	85.08	200.0	"
94	"	" "	600	10.00	8.98	2.7	12.8	76.12	304.8	"
95	A. N. Ault	Forest Grove, Washington	375	15.24	15.00	6.0	21.3	71.54	266.0	Vilmorin Improved.
96	E. F. Meissner	Kerby, Josephine	393	16.00	15.20	5.5	21.5	74 41	320.0	Early Rose.
97	A. J. Thompson	Oswego, Clackamas	325	15.20	14.40	2.3	17.5	86 85	314.0	" "
98	J. J Odale	Union, Union	405	16.10	15.20	1.6	17.7	90.95	332.0	Klein Wanzlebener.
99	A. J. Goodbrod	" "	817	23.00	21.90	3.9	26.9	85.50	460.0	" "
100	College Farm	Corvallis, Benton	2468	12.60	11.90	1.8	14 4	90.95	252.0	" "
101	" "	" "	2900	11.20	10.60	2.0	12.6	88.80	224.0	Vilmorin.
102	" "	" "	3326	15.50	14.70	2.2	17.7	87.50	301.0	White Imperial.
103	" "	" "	4526	13.90	13.20	1.8	15.0	92.60	278.0	Early Rose.
104	S. P. Reeder	Greenville, Jackson	532	18.20	17.30	3.8	22.0	78.68	374.0	White Imperial.
105	College Farm	Corvallis, Benton	270	12.70	12.00	2.7	14.7	86.53	254.0	Klein Wanzlebener.
106	" "	" "	300	12.60	12.00	1.4	14.0	90.00	252.0	Vilmorin.
107	" "	" "	303	13.90	13.10	1.8	15.7	89.10	278.0	White Imperial.
108	" "	" "	305	10.00	9.50	1.7	11.7	85 88	200.0	Early Rose.
109	T. E. Hills	Ashland, Jackson	783	15.00	14.20	2.7	17.7	84.74	300.0	Desprez Early Rose.
110	J. M. Hirsch	Union Union	605	17.00	16.20	1.5	18.5	93.40	340.0	Unknown.
111	College Farm	Corvallis, Benton	340	11.00	10.40	3.2	14.2	77.40	220.0	Klein Wanzlebener.
112	" "	" "	490	9.80	9.30	3.1	12.9	76.29	196.0	Vilmorin.
113	" "	" "	263	11.40	10.80	1.2	12.6	90.46	228.0	White Imperial.

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114	College Farm	Corvallis, Benton	296	13.70	13.10	1.7	15.4	88 97	274.0	Early Rose.
115	H. Buxton	Forest Grove Washington	1970	11.90	11.30	2.1	14.0	85.00	238.0	"
116	"	" " "	525	13.10	12.40	3.0	16.1	81.47	262.0	"
117	"	" " "	1045	14.30	13.60	1.8	16.1	88.80	286.0	"
118	T. R. Cornelius	Cornelius, Washington	567	12.00	11.40	3.0	15.0	80.00	240.0	Desprez' Early Rose.
119	George R. Woodruff	Philomath, Benton	620	9.40	8.90	2.1	11.5	87.70	188.0	Early Rose.
120	"	" "	640	12.90	12.30	2.8	15.7	82.17	258.0	Vilmorin.
121	"	" "	776	11.90	11.20	2.6	14.5	82.17	238.0	Klein Wanzlebener.
122	M. P. Jones	Perrydale, Polk	1022	13.40	12.70	1.4	24.8	54.10	268.0	Vilmorin.
123	W. C. Tower	Oakland, Douglas	1938	20.60	19.60	3.7	24.3	84.32	412.0	White Imperial.
124	J. D. Rowell	Scholl's Ferry	341	19.00	18.00	9.0	28.0	67.80	380.0	Klein Wanzlebener.
125	College Farm	Corvallis, Benton	375	... ...	... ...	....	... ..	... ...	.....	Early Rose.
126	" "	" "	367	14.40	13.50	2.4	16.8	85.70	288.0	Klein Wanzlebener
127	" "	" "	250	16.70	15.80	2.2	18.9	88.30	234.0	White Imperial
128	B. D Dyer	Myrtle Creek, Douglas	291	11.30	10.80	3.0	14.3	79.02	226.0	Unknown.
129	B. E. Cartwright	Eugene, Lane	568	15.10	14.30	2.9	18.0	83.09	302.0	Desprez' Early Rose.
130	Michael Lemmer	Roseburg, Douglas	458	15.00	14.20	1.6	16.6	73.40	300.0	Klein Wanzlebener.
131	O P. Pointer	Hillsboro, Washington..	538	14.70	14.00	6.0	20.7	71.80	294.0	White Imperial.
132	M. Snyder	Plainview, Linn	617	17.10	16.20	6.1	23.3	73.40	342 0	Early Rose.
133	J. D. Leonard	Carlton, Yamhill	756	18.70	17.70	5.7	24.4	76.60	374.0	Klein Wanzlebener.
134	Jas. Edson	Ballston, Polk	1416	19.30	18.20	5.7	25.0	77.20	386.0	White Imperial.
135	S. W. Gaines	Hubbard, Marion	558	14.60	14.00	6.7	21 3	68.50	292.0	Unknown.
136	M. O. Lownsdale	Lafayette. Yamhill	980	14.00	13.30	3.0	17.0	82.90	280.0	Early Rose.
137	"	" "	1050	12.50	12.00	3.4	15.9	78.00	250.0	Klein Wanzlebener.
138	C. J. Bishop	Tidewater, Lincoln	860	14.20	13 40	2.5	16.7	85.00	288.0	Early Rose.
139	M. J. Duffy	Cove, Union	676	21.50	20.40	2.9	24.4	88.10	430.0	Unknown.
140	R. S Reede	Creswell, Lane.	660	15.30	14.40	2.7	18.0	85.00	306.0	Vilmorin.
141	B. C. Hawley	Logan Clackamas	352	15.10	14 30	1.9	17.0	88.80	302.0	Klein Wanzlebener.
142	J. K. Simpson	North Yamhill, Yamhill	351	14.80	14.10	2.2	17.0	87.00	296.0	Desprez' Early Rose.
143	B. F. Church	Monmouth, Polk	770	15.40	14.40	1.6	17.0	90.58	308.0	Vilmorin.
144	W. E. Church	Vale, Malheur	570	22.20	19.10	3.6	23.8	84.90	404.0	Desprez' Early Rose.
145	C. D. Nain	Ballston, Polk	1623	14.00	13.30	4.6	18.6	74.20	280.0	White Imperial.
146	J. H. Rinck	Buxton, Washington	165	17.70	16.80	4.1	21.8	76.60	354.0	Klein Wanzlebener.
147	William Bogue	Toledo, Lincoln	873	15.00	14.20	3.6	18.6	80.60	300 0	Early Rose.
148	Z. W. Beatty	Chemawa, Marion	840	13.00	12.30	3.1	16.1	80 70	260.0	Vilmorin.
149	R. S. Barclay	Tidewater, Lincoln	210	19.40	18.40	3.5	22.9	83.40	388.0	White Imperial.
150	C. C. Stanley	Imbler, Union	310	23.80	22.60	2.1	25.9	91.90	476.0	Desprez' Early Rose.
151	John End	Warmic, Wasco	330	21.10	20.00	2.2	23.3	90 50	422.0	Early Rose
152	E. F. Meisser	Kebyville, Joephine	400	15.40	14.60	2.1	17.5	88.00	308.0	Desprez' Early Rose.
153	J. H. Bard	Oakland, Douglas	623	14.50	13.70	4.1	18.0	77.90	290.0	White Imperial.
154	"	" "	843	16.10	15.30	5.1	21.2	75.90	322.0	Unknown.
155	P. J. Bond	Peel, Douglas	225	14.10	13.40	1.8	15.9	88.61	282 0	"
156	"	" "	246	21.50	20.40	2.4	23.9	85.77	430.0	Klein Wanzlebener.
157	J. E. Reynolds	La Grande, Union	633	20.90	19.80	2.4	23.3	85.42	418.0	Desprez' Early Rose.
158	Robert Deal	" "	236	16.20	15.30	6.1	22.3	76.04	324.0	Early Rose.
159	F. Clairhorn	Oakland, Douglas	323	13.50	12.80	3.1	16.4	82.30	270.0	Vilmorin.
160	W. H. Norcross	Central Point, Jackson	803	10.90	10.30	2.2	13.1	83.20	218.0	White Imperial.
161	A. H. Sampson	Lewisville, Polk	930	11.30	10.70	4.6	15.9	71.00	226.0	Vilmorin

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Table XXI (Continued)
Showing Analyses of Sugar Beets, 1891-1896.

	GROWER.	LOCALITY. POST OFFICE AND COUNTY.	Weight in Grams.	SUGAR. Sugar in Juice.	SUGAR. Sugar in Beet.	Solids not Sugar.	Brix.	Purity.	Pounds Sugar per Ton.	VARIETY OF BEET.
451	H. L. Heath	McMinnville, Yamhill	.....	11.55	10.97	1 45	13.0	88.84	231.0	New Danish.
452	" "	" "	.....	12.10	11.79	.90	13.0	93.04	242.0	French.
463	D. K. Bill	Hillsboro, Washington	.....	13.60	12.92	3 40	17.0	80.00	372.0	Unknown.
464	Max Steaples	" "	.....	14.20	13.49	4.00	18.2	78.02	284.0	"
465	W. H. Bucher	" "	.....	13.90	13.20	4 30	18.2	76.37	278.0	"
466	B. W. Thorne	" "	.....	14.90	14.16	4.00	18.9	79.36	298.0	"
487	W. B. Kingley	McMinnville, Yamhill	.....	13.00	12.35	... ..	... ..	... ...	... .	"
589	College Farm	Corvallis, Benton	400	12.60	11.97	4.20	16.8	75.00	252.0	Kielholz Klein Wanzlebener.
590	" "	" "	456	14.40	13.60	3.30	17.7	81.35	288.0	Lion Most Saccharine.
591	" "	" "	665	14.70	12.70	2.30	16.8	86.31	290.0	" Improved Imperial.
732	John Henry	Beaverton, Washington	281	18.30	17.39	2.80	21.1	86.70	366.0	White Imperial, German.
748	R. Kuhne	Tigardville, "	275	17.00	16.15	1.60	18.6	91.40	340.0	Klein Wanzlebener.
749	"	" "	337	16.60	15.78	2.00	18.6	89.20	322.0	Vilmorin, blanche ameliore.
750	"	" "	268	17 80	16.91	2.50	20.3	88.60	356.0	Kuhne's Improved.
751	"	McKee, Marion	149	17.30	16.44	3.00	20.3	85.20	346.0	Unknown.
755	H. E. Dosch	Hillsdale, Multnomah	264	16.90	15.45	5.10	22.0	76.80	338.0	"
756	John Henry	Beaverton, Washington	279	18.80	17.86	1.60	20.4	92.10	376.0	White Imperial, German.
757	"	" "	305	16.10	15.22	6.50	22.6	71.10	322.0	Klein Wanzlebener.
759	R. Kuhne	Tigardville, "	326	15.40	14.63	1.00	16.4	93.00	308.0	Vilmorin.
760	"	" "	.....	12.40	11.78	2.40	14.8	90.70	248.0	"
761	"	" "	223	16.50	15.70	3.70	20.2	81.10	330.0	Klein Wanzlebener.
762	"	" "	198	14.00	13.20	4.00	18.0	77.70	280.0	" "

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Table XXII

Showing Analyses of Oregon grown Sugar Beets made by the Department of Agriculture at Washington, D. C.*

GROWER.	COUNTY.	Weight in Grams.	Sugar in Juice.	Sugar in Beet.	Purity.	Solids.	VARIETY.
Herman Benke..	Benton	370	13 88	15 18	79 3	17 49	German.
J. J. Nye.....	"	355	13 30	12 65	78 4	16 97	"
C. J. Bishop..	"	335	15 40	14 63	87 5	17 61	Bulteau Desprez.
G. H. Rosebrook	"	300	14 05	13 35	83 1	16 89	Klein Wanzlebener.
Henry Delinger..	"	1589	15 05	14 30	85 4	17 64	
Average.....	.....	628	14 34	13 71	82 8	17 32	
Thomas Daniels	Clackamas ...	500	19 88	18 88	87 6	22 68	
O. P. Yoder.....	"	105	14 55	13 82	86 5	16 83	Klein Wanzlebener.
Richard Scott.,..	"	1155	12 25	11 62	77 0	15 91	" "
Average.....	.....	586	15 56	14 78	84 2	18 47	" "
Clarence Reed.....	Columbia.....	275	16 50	15 67	83 9	19 67	" "
"	"	830	15 60	14 82	79 8	19 67	" "
J. C. Johnson.....	"	535	13 90	13 21	86 0	16 17	
Average... ..	.....	546	15 30	14 56	81 7	18 50	
J. M. Perkins.....	Coos.....	1030	13 00	12 35	80 8	16 31	Klein Wanzlebener.
Mat Kerrigan.....	"	600	14 50	13 77	83 8	17 31	Vilmorin.
"	"	530	14 65	13 92	80 5	17 71	Klein Wanzlebener.
John Fox..... ..	"	975	16 80	15 96	87 0	19 31	
T. T. Smith.....	"	865	13 85	13 16	79 1	17 51	Vilmorin Improved.
Average.....	....	860	14 56	13 83	82 6	17 63	
W. L. Tower.....	Douglas.....	340	17 74	16 85	84 3	21 03	German.
Edward Albright	Jackson	570	18 94	17 99	83 9	22 57	
J. G. Stevenson..	Lane	115	12 15	11 54	77 5	15 67	Vilmorin Improved.
W. N. Crow.....	"	595	14 05	13 36	77 7	18 09	
H. L. Perkins....	"	475	13 95	13 25	81 2	17 17	
J. H. Crow.....	"	230	17 50	16 63	84 6	20 68	
C. J. Dodd.....	"	815	15 10	14 35	83 9	17 99	French.
L. Martin.....	"	1100	12 67	12 05	82 5	15 35	
Average.....	.....	550	14 24	13 53	85 4	17 49	
John Withers....	Linn.....	180	14 15	13 42	79 5	17 81	
Jacob Raber.....	Marion	1365	12 35	11 73	76 2	16 17	
Jacob Voorhees..	"	560	14 45	13 73	85 7	16 87	
Average.....	....	962	13 40	12 73	81 1	16 52	
James Douglas..	Polk	880	12 10	11 50	79 8	15 17	German.
J. E. David.....	Sherman	435	13 55	12 86	72 2	18 77	
J. H. Logan.....	Umatilla	395	15 12	14 36	80 9	18 69	French.
W. R. Wise.....	Union	980	14 10	13 40	81 0	17 39	
"	"	1130	14 55	13 82	82 6	17 59	
Average.....	....	1055	14 32	13 61	81 8	17 49	
J. H. Rinck.....	Washington..	250	12 67	12 04	85 8	14 77	Klein Wanzlebener.
A. N. Ault.....	"	430	15 00	14 25	82 0	18 29	Vilmorin.
"	"	1365	9 80	9 31	68 3	14 38	"
Average.....	....	681	12 49	11 86	80 7	15 48	
Average for the state.....		644	14 57	13 84	82 2	17 72	

*Compiled from Bulletin No. 33, U. S. Department of Agriculture.

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Oregon Agricultural

EXPERIMENT STATION.

Bulletin No. 45. - - June, 1897.



Prunes in Oregon.

"Dryed plums, which are commonly called Prunes, are wholsomer, and more pleasant to the stomacke, than the greene plums: they yeeld much better nourishment, and such as cannot easily putrifie, by reason that their crude and superfluous moisture is dryed up and consumed. The Damask and Spanish Prunes are the best, because they are the sweetest: being boyled in brothes, they loose the belley, and excrete out choler: being stewed and eaten betweene or before meales, they are most pleasant to the taste, excellently refresh a weake stomacke and doe also mollifie. They are most convenient for them that are of a cholericke or sanguine constitution. French Prunes, and all such as are somewhat sour in taste, are somewhat of a binding, and not of a soluble faculty."

Published in London in 1628 by T. VENNER, "Doctor of Physics."

The Bulletins of this Station are sent free to all residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE
L. M. LELAND, G. M. CLARK, Printers.
Corvallis, Oregon, 1897.

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PLATE I. SHOWING WELL CULTIVATED ORCHARD.

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Oregon Agricultural College.

Corvallis, Oregon, January.— 1897.

The following bulletin on prunes is respectfully submitted to the fruit-growers of Oregon. The bulletin is the outgrowth of a demand among our fruit-growers, in the beginning of an almost new industry, for information dealing with the known facts and methods relative to the industry. The bulletin is, then, essentially only a preliminary report, facts being as yet too meagre and fragmentary to allow of a finished account being published. The writers only hope that it is up to date in the teachings and conclusions set forth and that they as fully as possible meet the demand for such information. Various problems touched upon in this bulletin are still matters of experimentation, to be more fully considered after conclusive results are obtained from experiments now planned or in progress; this is especially true of all questions relating to the evaporation of fruits, to certain diseases and insects, and to some chemical problems. Some parts of Bulletin No. 40, "Prunes, Apples, and Pears in Oregon," are incorporated in this bulletin.

U. P. HEDRICK, Horticulturist and Botanist.

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IS THERE PERMANENT PROSPERITY FOR THE OREGON PRUNE INDUSTRY?

APPLICATION OF THE LAW OF VALUE TO THE PROBLEM.

H. B. MILLER, Director of Station.

Many persons are misled in their selection of crops by not having a clear conception of the law governing values. If a big price is realized this year for a given product, thousands of people rush into the business and soon the market is demoralized. The market price of a thing is only one side to the law of value, and before we engage in the permanent production of anything like prunes, we must examine the other and more important as well as the more difficult side of the question; and that is the cost of production. The cost of production in this sense includes growing, curing, preparing and sending to market. After becoming convinced of a permanent demand for a thing, the next step to consider is the natural advantages of production and transportation. This is a broad field and one requiring much careful thought and deliberation.

If the climatic and soil conditions in France, Austria-Hungary or any other foreign country, be better for the production of prunes than this country; if the cost of labor is also permanently less, and the cost of transportation to our market no greater than ours, then it would be folly for us to engage in the business unless the government provides a protection by tariff legislation.

If we have advantages of soil, climate, transportation and labor cost, over any foreign country, or not having these, the government provides for any or all of these deficiencies by a protective tariff; then the scope of our investigation is reduced to our own country, provided that the market is here.

The consumption of prunes in the United States is growing rapidly. In 1891. the importation of prunes to the United States was 34,000,000 lbs., and the production was 29,000,000 lbs.

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The consumption could not have exceeded 63,000,000 lbs. of prunes in a dried state. In 1895, the importation was 14,000,000 lbs. and the production about 69,000,000 lbs., showing an increase in consumption of about 20,000,000 lbs. in four years. The consumers pay from ten to fifteen cents per pound for these. When the consumers can procure these prunes at from six to ten cents per pound, as they should and will no doubt ere long, the consumption of prunes will demand a larger production.

The prune grower can look for a much greater consumption of prunes and a more certain and steady market in the future, with a much greater degree of certainty than he can expect increased prices. A strong healthy and reliable market even at past prices, is much more to be desired than an uncertain and fluctuating market.

As to the production of prunes in this country, it seems to be settled, for various reasons, that no other section of the country can compete with the Pacific Coast.

The prospect of a market being assured, the next problem to consider is, — can we compete with California, the greatest prune producing section of the world? If their cost of production is from a half to one cent a pound less than ours, then they will eventually kill the industryin Oregon. California makes a claim of producing a better grade prune; one containing more sugar. While their claim is not altogether true, there is no reason for us to be discouraged if our cost of production is low, for the question of permanent success hinges upon the cost of producing good fruit for the masses. If after a careful examination of all the facts relating to competition with California, we become convinced that the industry can be made a success here, and we concluded to engage in prune growing in Oregon, then we have to consider the same question again, and determine which section of Oregon will produce prunes the best, for there is a great difference in the different parts of our own state. After having determined which section of the state is the best suited, we must still keep the cost of production in view. Will we get the largest and best continuous crops from sandy loam, river bottom land, the ordinary gray valley land, or the red hills? Look at the subject from any point you will, the economic law of cost of production must be the primary factor. If other sections with their natural

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influences, can produce them at a less cost, it is folly to rely upon the expectation of an exorbitant price and engage in the industry on wild hopes of a great market. The lowest cost of production for the market will win the day in the production of fruits as in all else.

Law of Value.

The value will be governed by the cost of producing the most expensive part of the required amount. For example, if it should cost one cent a pound more to produce prunes in California than in Oregon and the market required the California product in addition to ours, there would be an assurance of profit to the Oregon producer. If one-third of the prunes raised are produced on hill lands at a cost of half a cent a pound more than on bottom lands, and the market would not take the prunes at the highest cost, then those engaged in prune growing on the hills would have to give up. It is a grievous mistake to engage in production simply on an examination of market rates. If the elements at command insure the lowest cost of production, then there need be no hesitancy whatever in entering the field with confidence and assurance of success if proper attention is given.

This law is so unerring that if the elements of it are followed there need be few failures. The cost of production of prunes in Oregon will vary from two to five cents per pound. Those who can produce at a cost close to this lower cost-line, are assured of a continuous and profitable industry, while those along the higher cost-line may depend upon a hard struggle with every prospect of failure.

In the production of prunes for market in the green state, the same law holds good, and must be the rule of action in determining the wisdom of any locality building up the business. This law is becoming clearer every year, in almost every line of industrial life as is shown by the specializing of manufactured as well as all kinds of agricultural products.

Any locality that can produce a certain line of marketable products the best with the least labor, is leading and producing profits in that line.

The question is constantly being asked—"Is there not great danger of overproduction of prunes?"—"Will it pay to engage in the industry?" Many who have already planted orchards are

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wondering whether or not the supposed overproduction will make it unprofitable for them to continue.

A careful examination of the principles outlined above, seems to answer this question completely. The question for the prune grower to determine is not—"Will there be an overproduction," but, "Can I produce near the lowest cost?" If there is an overproduction, those laboring under the most expensive difficulties and whose cost of production is along the higher margin, will be the ones who must discontinue the business; while those whose production is the cheapest can continue with an assurance of profit. The whole question of prune producing in Oregon must be solved by those who undertake it, through the practical competition of cost of production.

There is too great a margin between the amount received by the producer and the amount paid by the consumer. This phase of the subject must eventually be solved by the producer. Prune growers' organizations, I believe to be the only practical method by which this margin of difference can be substantially and permanently reduced.

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PRUNE GROWING IN OREGON.

U. P. HEDRICK, Botanist and Horticulturist.

1. General Culture.

INTRODUCTION.

The prune interests are greater than all other orchard interests in Oregon. Within the last half decade the industry has grown from insignificance to be one of the large commercial enterprises of the state. If the market for the product, dried and green, increases in the future as in the past the outlook is most promising for a great industry; for, the prune in Oregon has much in its favor. Climatic conditions are good; the soil is such that productiveness is insured; and there is a comparative immunity from pests. With these advantages Oregon can safely defy competition in the cost of production of prunes, and prune growers can rest assured that there is a good foundation for their industry.

There are about 26,000 acres devoted to prune growing in Oregon. Prunes are grown throughout the western part of the state and along the Columbia and its tributaries in Northern and Eastern Oregon, but the major part of the industry is comprised in the Willamette and Umpqua River valleys. In the Willamette Valley, there are about 15,000 acres of prune orchards. As yet most of these orchards are on the black alluvial soil near the river and have not to any appreciable extent encroached upon the red hill soil farther away, though that this soil will produce prunes is certain. The second largest prune district is in the Umpqua River Valley. Here there are about 6,500 acres of prune orchards. The valley of the Umpqua seems to be the most favored region for prunes, trees and fruit reaching their highest perfection there. The Petite or French prune especially seems to thrive; the Italian can be as well, and perhaps better, grown in the Willamette Valley. The Petite prune, and the Italian more or less, are grown very successfully in the Rogue River

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Valley also, where there are approximately 1,500 acres. Attempts are being made to grow prunes in Hood River Valley and along the Columbia in Eastern Oregon, but experienced orchardists say that these sections cannot well compete with the more favored prune localities, and that their splendid fruit resources can be used to better advantage in growing other fruits. In these districts there are about 2,500 acres.

CLIMATE.

One of the resources of Oregon is its climate. An adequate estimate of its functions and value as a factor in producing prunes, and its influence upon prune growing, would lead us far beyond the limits of a brief bulletin.

The horticultural effects of the Willamette Valley climate are as follows. All fungous diseases are more prevalent than in the higher and drier valleys. The great prune pest of the state, shot hole fungus, finds a more congenial home and is far more rampant in the Willamette Valley than elsewhere. Brown rot newly introduced into the state, is as yet found only here and will soon be a grievous pest. In the humid atmosphere, moss and lichens quickly cover the trees. Strong winds, a feature of Willamette Valley climate, make it necessary to head low and prune so as to secure strong, stocky trees. Sunburn is not so common as in the warmer and drier valleys. Fruit ripens from one to three weeks later than in the other valleys. Deficiency in sunlight and summer heat makes the growth of some varieties of prunes unsatisfactory.

The chief horticultural effects of the Umpqua, Rogue, and Hood rivers valleys and Eastern Oregon climates, are, in comparison with the Willamette Valley, fewer fungous, but more insect pests:— San Jose scale, red, and yellow spider are more plentiful, except, perhaps, in Hood River. There is an earlier and more perfect ripening of fruits, especially those of summer and autumn, because of the continual sunshine and dry air. On the other hand, Italian prunes do not attain their full size and best characteristics because of being forced into early maturity. Injuries from hot winds and sun-scald are more frequent. Local influences governed by topography are much more marked in these valleys, making it important that fruit locations be selected with great care. More attention must be given to the special

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conditions and natural agencies which contribute to the development of fruit in any location. The rainfall is much less and the atmosphere not nearly so humid so that in some places prune growers may have to resort to irrigation.

The same causes that make the differences in the various valleys make local variations also, and these need always to be taken into consideration by the fruit-grower. There are, for example, all through the state small valleys protected from cold winds and heavy fogs and open to sunshine which produce fruits earlier in the season, and of better quality, than locations not so favored. Elevation ministers to the same effect. Rivers moderate climatic influences somewhat. In general, then, the metes and bounds of latitude are set aside somewhat by local modifications, and the intelligent fruit-grower who chooses his location in accordance with climatic condition, will find in the climate a valuable ally.

SOILS.

Soils and stock are intimately related, but of the latter we shall speak hereafter. Prunes thrive best in a rich, loamy, river bottom soil, as is well demonstrated by the splendid orchards grown on that soil in Douglas county. The second best soil is the black loam of the valleys, always provided that it is well drained. At present, most of the Willamette Valley orchards are in this soil, and better ones can hardly be produced, when other conditions are proper. The red lands are third in the list of soils, but as to whether they are desirable is yet to be determined. Great care in selecting locations on red lands must be taken in regard to depth of soil. One of the grievous mistakes made by planters all through Western Oregon is that of planting on shallow soils. This is especially true on the red lands. The minimum depth of soils for prunes is four feet, and as much deeper than that as possible is desirable. Fine prunes are grown on granite soils, but these soils are not lasting and must be irrigated if best results are to be had. The above claims for the various soils are not arbitrary. In fact, location, drainage, and depth of soil have almost as much to do with prune growing as does the kind of soil. It must be remembered that there are infinite gradations between the various soils.

The prune tree is a gross feeder, its limbs growing often-

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times several feet in one season, so whatever the soil, it must be rich. On the other hand a soil may be too rich, producing a weak, watery growth not at all desirable. Prunes contain a large amount of water so that it is necessary to have a soil somewhat retentive of moisture, and also one that can be thoroughly tilled, that being essential to proper conservation of moisture. But, as before stated, the land for prunes must be thoroughly drained. This is to be emphasized at all times since one of the great faults of the prune orchards of Oregon is that they are not on properly drained land. Briefly, the ideal soil for a prune orchard is: a rich, sandy loam, warm, mellow and deep, containing sufficient vegetable humus to give lightness and retain moisture without being damp and heavy, and having good natural or artificial drainage. The character of the soil is not to be determined by surface appearance but by thorough examination.

Procuring Trees.

Oregon is well supplied with good nurseries and a grower can get first-class trees, but many hardly know what they want. One of the chief complaints among the prune growers is in regard to young trees. Procuring trees is so largely a matter of business and good judgement, that anything which any one aside from the buyer could say would be of little value, but a word or two in a general way will be proper here. Patronize the nearest reputable nursery-men, endeavoring to get stock at a low price, but not purchasing simply because of cheapness. Buy only first-class trees, one or two years from the bud, having as an ideal, trees of medium size, with straight, stocky, hard growth; clean trunks; free from borers, insects and injuries; and a perfect union of stock and scion. Have your trees shipped as soon as they can be easily dug, and set them as soon as possible, having the ground in the best condition. Buy only varieties which show the greatest adaptability to your particular location, a point which seems trite, but which nevertheless is not always observed. Varieties in unsuitable locations and mixed orchards are such common faults that particular attention is called to the fact, that only those you know will do well should be planted.

Stocks.

Prunes can be and at one time were grown on their own roots, but their habit of sending up suckers condemmed this

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practice. Peach roots were next adopted as a stock upon which to grow them, but in nearly all prune and plum growing regions, excepting the Pacific Northwest, the peach was discarded for the myrobolan plum chiefly; but recently, because it is said to sucker, to dwarf the scion, and to be hard to propagate from cuttings in quantities, the myrobolan has fallen somewhat in disfavor, and the Marianna takes its place in popular favor. The writer is satisfied that peach stocks have been used too commonly in Oregon and that the poor orchards on the heavy, cold, damp soils are largely attributable to the fact that peach stocks were used.

In the prune bulletin issued last year, information concerning any orchards growing on myrobolan or Marianna stocks was asked for. Several letters came telling of experiences with these stocks. I have been able also to visit some orchards having trees growing on myrobolan and Marianna roots. After a careful study of the question in the orchard and from the experience of others I present the following in regard to the relative merits of peach, myrobolan, and Marianna stocks.

The peach is not desirable in Oregon because there are few soils in the state upon which peaches will thrive; peach roots require better drainage than can commonly be given in Oregon; peach stocks are grown from seeds and as each seed produces a tree different from every other one in habit of growth and vigor it follows that the stocks vary in their capacity to develop a good prune tree. Pits for stocks are obtained from fruits too poor for market and hence always have a tendency to degenerate; prunes do not always take well on peach roots and must often be double "worked;" peach stocks are quite susceptible to borers and to diseases so that a prune on peach stock has a precarious and often a short life. In general, then, peach stocks should be used only when a prune orchard is to be set on a strikingly good peach soil.

From the experience of some of our nurserymen and the descriptions given of their myrobolan and Marianna stocks, I fear that in our state the two varieties are sadly mixed, and so before discussing their relative merits as stocks it may be well to distinguish between them.

In his work upon native plums,* Prof. L. H. Bailey, who

*Bulletin 38, Cornell University Agricultural Experiment Station.

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has probably given the subject more study than any other horticulturist or botanist, says that the myrobolan belongs to *Prunus cerasifera* and that "the Marianna is either the same species or a hybrid between it and some American plum, possibly the Wild Goose." The following are descriptions of the myrobolan and the Marianna plums,—of the myrobolan as typified by the variety, De Caradeuc,—taken from Bailey.*

"De Caradeuc.—(myrobolan.) Rather large (1 to 1¼ in. in diameter), globular, deep dull purple red when ripe with a prominently colored suture but yellowish green splashed with red when it first becomes edible: flesh thin, very juicy and sweet: cling, the stone rounded ovate, rather turgid, scarcely pointed and evenly pitted; leaves rather firm, ovate oblong. Early. In central New York it ripens from the first to the middle of August (a little later at the Oregon Experiment Station. U. P. H.) Tree, an erect grower.

Marianna.—Large, round, oblong; short stemmed as compared with the De Caradeuc, bright red and finely speckled and covered with a thin bloom; flesh soft and sweet, juicy; semi-cling, the stone like that of De Caradeuc; flowers small, sessile on short stalks in dense lateral clusters like the native varieties, the calyx lobes, narrow and erect; leaves much as in De Caradeuc; a little later than De Caradeuc, but ripens before the Wild Goose. Tree a very spreading grower. C"

It must be remembered that both myrobolan and Marianna as seedlings vary much. The relative merits of the two plums as stocks can only be determined by longer experience. In the past, myrobolan has been mostly used and is to my mind much superior to the peach. Just now, however, there seems to be a well founded opinion that the Marianna is better than the myrobolan for the reasons that it does not dwarf the tree, seedlings do not vary so much, it does not sucker as much as the myrobolan, unites with all varieties while the myrobolan does not, and lastly the cuttings of Marianna root much easier than those of the myrobolan, a point of much importance since properly all stocks should be propagated from cuttings. The indiscriminate use of variable seedlings is to be condemmed, as much of the trouble with stocks can be laid to this cause. In this connection it is well to say that in setting stocks from cuttings if uniform results are to be obtained, particular strains should be used and not anything that may happen to be on hand. It is claimed by those favoring the seedlings that the roots formed from cuttings are weak and in the end make a poor root system and

*Bulletin 38, Cornell University Agricultural Experiment Station.

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that oftentimes cuttings are diseased in the roots while seedlings are almost universally healthy. Theoretically there are no reasons why a tree from a cutting is not as good as one from a seed, and it is not at all hard to find good thrifty orchards that have been so grown. It is said that most of the myrobolan stocks in California are grown from cuttings.

Fruit-growers often want to grow their own stocks. For such as may want to grow them from cuttings the following method is advised. Nurserymen usually have their own ways of growing them. Cuttings should be taken before the sap begins running in the spring from well ripened wood of the previous year's growth. They should be from six to ten inches long, two-thirds of the length to go in the ground. The soil best adapted for growing them is a good rich loam, well drained and yet always moist as tender roots die quickly in dry ground. The cultivation should be that usually given to seedlings or tender plants just starting to grow.

We advise any one contemplating putting out a prune orchard to thoroughly look into the matter of stocks. Many grievous mistakes have already been made in selecting trees with peach roots. Longer experience will determine the relative value of myrobolan and Marianna stocks just as it has determined their superiority to the peach.

Draining and Subsoiling.

The notion seems to prevail in Oregon that land does not need to be drained for prunes. At least in the hundreds of orchards in the state there are hardly a score that have been drained. With drainage as with fertilization people have the erroneous opinion that a prune orchard can get along without it. To be sure we have a great deal of naturally well drained soil upon which it would be useless to spend money in laying drains, but in the major part of our prune orchards the character of the land is such that water is held in the soil until evaporated from the surface, keeping the soil in such conditon that the roots of the trees are injured and proper spring cultivation is absolutely prohibited. The whole trend of the information obtained from prune men in regard to the ills of their orchards points to drainage as one of the first of the great fundamentals of a rational system of prune growing in Oregon. The need of it can hardly

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be over-estimated and fruit-growers must come to look upon the lack of it as the direct and indirect cause of a multitude of the ills of their orchards. Let us glance at a few of the things to be gained by good drainage.

The essential mechanical features of good fruit land demand drainage. There must be an ability to get rid of surplus water if any orchard tree is to grow and thrive, even if the water is only over abundant when the tree is dormant. Proper drainage helps to retain moisture in the dry season, since, if soil has too much water it becomes puddled, then bakes, and sun and wind quickly evaporates all moisture from it. Well drained land is warmer in spring and fall because of not having the cooler water in it; it is cooler in the heat of summer, when proper root growth demands an amount of moisture, coolness, and circulation of air, that can not be had in a baked, parched, soil. A boggy, miry condition of the soil prohibits cultivation often times when it should be given, and so hinders good tillage. Good drainage makes available plant food that is otherwise lost. By allowing a free passage of currents of air, carrying with them rich substances, in the atmosphere, it helps to fertilize a soil. There are still other conditions, which added to these, make underdrainage, as a rule, absolutely necessary in our prune orchards.

We give the following brief directions in regard to the construction of underdrains. Information is easily available from other sources so we need not go very deep into the subject in this connection. Size of tile varies with the amount of water to be carried off, though in Oregon they should never be smaller than three inches because of the great amount of water to be carried off at certain seasons; a row of tile to every two rows of trees would be a good rule thus making the drains 36, 40, or 44 feet apart; the proper depth is, on most lands, about three feet; tile can be as well laid at one time as another provided the ground is soft from the rains; a surveyor should always be employed to run the levels, otherwise the system is almost sure to be unevenly laid. Good burned drain tiles can be obtained in almost all parts of the state and should be used even though the planter lives at some distance from the factory, as open ditches, cobblestones, mole drains, or any cheap substitute is but a temporary makeshift.

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In Eastern Oregon dynamite is being used to a limited extent as a means of breaking the hard-pan so that the water can drain through. I believe the method is not an unqualified success both because of expense and inefficiency. On alkali soils, to allow the alkali to be carried downward the same method has been used with a show of success.

Intimately connected with drainage is subsoiling. What has been said about the necessity of drainage largely applies to subsoiling. It is a peculiarity of Oregon soils that you cannot judge the subsoil with any certainty whatever from the surface, nor can you infer that the same subsoil extends for any great distance under the same surface soil. Conditions vary so that every fruit-grower should examine his soil in several places and judge for himself whether any part of his orchard needs subsoiling.

Any soil having an open porous subsoil cannot be benefitted by having the soil made more open. But any soil upon which water stands, or runs off, having a subsoil that is at all compact, and to any great degree impervious to water, ought to be subsoiled. Oftentimes deep plowing will help to accomplish this object. But generally an implement which can be pulled through this compact soil, breaking and loosening it up, must be used. The nature of the soil determines the depth of subsoiling.

Like drainage, subsoiling tends to dispose of surplus water, allowing it to filter through the hard-pan, and also helps to retain it in a dry season, since the water sinks lower in the ground and is not so easily evaporated, but rises gradually by capillary attraction. The act of subsoiling tends at first to dry out a soil, and unless a rain follows before crops are put in may in this way be for a time injurious. Therefore, subsoiling ought to be done sometime before a crop is planted that the soil may contain the proper amount of moisture. The after-cultivation of land that has been subsoiled should be as shallow as possible, thus by mulching the evaporation is checked and moisture is retained. Such cultivation should be frequent and long continued.

Setting Trees.

There are a few points about setting trees which need emphasizing. It is obvious, first of all, that the rows must be straight. Any man with ingenuity and a "good eye" can secure this result. So far as trimming trees before planting is concerned,

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it is advisable to cut away all roots which are broken and injured, since a smooth wound will heal more quickly than a ragged one. Roots of inordinate length may of course be cut back to make a symmetrical root system. When a tree is dug, half of the fibrous roots are left in the ground; the top, therefore, ought to be cut back a corresponding amount, or more, since it will require some time for the roots to resume vital activities. Trees not so trimmed often fail to grow at all, or if they do start, are, in their weak condition, destroyed by drouths or pests.

The following rules for tree planting are always in order. The soil should be well firmed about the roots of trees; the roots straightened out in approximately their natural position; the hole should be large and roomy; the earth fine and dry enough to crumble; the tree to be set a little deeper in the soil than it stood in the nursery row; the roots of the tree must not be long uncovered; and every care must be taken to get the tree in its natural environment as quickly as possible. If the operation of tree planting is to be perfect these details must be observed.

Distance Apart.

It is almost a universal fault throughout the state for prune growers to plant their trees too close together. The shrewd growers are convinced of this and will tell you not to plant less than twenty-two feet apart. The Petite prune, perhaps, may be well grown at twenty feet. Trees are gross feeders and need plenty of room. Additional reasons for a greater distance apart are, that it allows of better cultivation, enables you to spray more easily, and it will give you a well formed, strong tree with an individuality of its own.

Cultivation.

The most widespread, and the most serious fault of Oregon prune orchards is *neglect*. Commonest among the many things neglected, is neglect in tillage. It must be said that prune orchards in general yield so abundantly without tillage that it is not to be much wondered at that the prune growers think they do not need tillage. Every orchard is so greatly influenced by special soils and conditions in which it grows that it is hard to attribute the behavior of an individual orchard to either tillage or the lack of tillage. But if a man thinks for a moment of the

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obvious effects of tillage upon any crop in the soil he will admit that cultivation is essential to any rational system of horticulture. Corn, potatoes, vegetables, all annual crops demand cultivation. Berries and fruits do not differ from vegetables in any of their activities of life, and that which benefits them must be as useful to these. Cultivation must be judicious or grievous damage to an orchard may result. There are underlying principles of the operation which must be interpreted with considerable skill if cultivation is successfully done. Just what proper cultivation is, must be determined by every man, for every farm, and for every season. Only general principles can be given and a few of these are as follows. All young orchards should be given perfectly clean cultivation. All through the state there are young orchards smothered in weeds the owner thinking it not necessary to cultivate until the trees begin to bear. *It is necessary to cultivate the first year* so that the trees may be rightly started and the roots sent deep enough into the soil to essape the plow and cultivator in future years. As the orchard comes into bearing, the cultivation, perhaps, need not be so thorough, the orchard itself, in its wood and fruit, being the indicator of the treatment needed.

Figures 1 and 2 show very strikingly the difference at six years of age between an orchard that has been cultivated from the start and one in which the owner thought it unnecessary to cultivate until the trees came in bearing. The orchards are of the same variety; the soil is identical; the orchards are in neighboring fields, and were planted under the same conditions and at the same time. The orchard shown in Fig. 1 has been plowed each spring and cultivated fortnightly until August. The orchard in Fig. 2 has been plowed in the spring and cultivated once or twice, occasionly three times, during the season.

Usually, sowed crops should be avoided in an orchard, since they forbid all chance of cultivation and use up plant food and moisture that should go to the trees. Occasionally, on an extremely rich soil, an orchard may be brought in bearing by sowing a crop of grain in it. There are no objections to growing hoed crops or small fruits in a young orchard, but the land must be well tilled and well fed, and it must be stopped when the trees comes in bearing as there is but little land that can be

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PLATE II, SHOWING NEGLECTED ORCHARD.

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worked on the share system—a good yield of fruit and of another crop at the same time.

Cultivaton should begin as early in the season as possible and should be given *frequently* thereafter until the time to cease comes, which, in this climate, is the middle of July or the first of August, this always to be governed by the growth the tree is making. Early cultivation is important since it warms up the soil, puts it in good mechanical condition; kills the sprouting herbage, and enables the trees to get quickly at work. Cultivation should stop as soon as the orchard has completed the desired growth so that the trees can ripen and harden their wood for the winter.

We are not sure but at this time a *catch crop* of rye, crimson clover, or some other quick growing plant might not be grown to advantage, to be plowed under in the spring. The merit of such a course would be that the unsightly crop of weeds which springs up after the summer's cultivation is finished, scattering its seeds to the four winds, certainly poor husbandry, would be destroyed; more important than this the mechanical condition of the soil would be greatly improved since it would keep it from running into a puddled mass in the winter, would dry it out more quickly in the the spring, and add very greatly to the vegetable matter of the soil. It would also aid in ripening the wood of the trees. This matter is only a suggestion, however, to be thought over by the grower. The practice is becoming a favorite one with Eastern orchardists and is recommended by Eastern writers.

In a young orchard it is advisable to plow the land each spring for several years. The after-cultivation should be with an implement, which with the minimum expenditure of time and labor will destroy weeds and keep the surface soil loose and friable. There are so many good implements that there need be no trouble in finding one suitable for any purpose. Disk harrows, spring-tooth harrows, clod-crushers, smoothing harrows, weeders, and cultivators all have their places. The reversible disk harrow, we find, is a favorite implement with many Oregon fruit-growers. The frequence with which one should cultivate, depends upon the soil, season, and purpose. Cultivating once a week some seasons is not too often especially if its object is to conserve the moisture. A crust should never be allowed to form

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or weeds to become established. The soil should always be left soft and fine if the fresh and grateful effects of a mulch are to be obtained; when left in this condition the roots are enabled to reach every portion of the soil, thus utilizing a maximum amount of plant food much of which otherwise might remain unavailable. An implement should be used which will allow of working close to trees so that high pruning need not be encouraged on account of close working.

Pruning.

Prune trees, generally, have been fairly well pruned in Oregon. It is an operation not at all difficult to learn since the advice given in horticultural books is plain and generally good. Opinions differ as to what the ideal tree after pruning should be. The concensus of opinion of the best growers, as we conceive it, would favor a tree about as follows: A medium, low, roundish, symmetrical top, upon which the fruit can be readily thinned and picked, the tree easily sprayed, and upon which there are strong branches, that will not break with a load of fruit, and that will shelter the stem from the sun. Such a tree will be vigorous, and long lived. While failures are not often caused by neglect in pruning yet they are aggravated by it, and the experience given from all sources presses home in the most convincing way the fact that careful and thorough pruning has much to do with the success of a prune orchard. A man of good judgment will not adopt arbitrary rules for pruning, but the following hints, may be of value to him.

In forming the head the branches should be distributed upon the different sides of the stock as much as possible. It should be formed by selecting several branches well distributed along the stem for a distance of one foot down from the top and pointing in such a way that the head becomes well balanced and symmetrical. The strongest upright branch should be left as the leading shoot and be so trained that other branches can be given off from it. Side branches should be well cut back.

After the head is formed an annual pruning should be given though branches or shoots out of place ought to be removed as soon as discovered. In Oregon, prune growers consider late winter the best time to prune, but the work can be done any time after the wood has thoroughly ripened and before the buds start

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in the spring. It is an almost universal fault in a prune orchard to find too much wood. There ought to be just so much wood with so much fruit, to secure which, you may either head back or thin out branches. If headed back, the cut should be made above a bud growing on the upper side of a limb so that the new branch will take a natural upward and oblique position, making a broad, strong branch with great weight bearing power. Be prudent in thinning out the branches of a prune tree as a tree will support many branches, having a tendency to "open up" as the branches become loaded with fruit. Crotches should be avoided, as when two branches of equal size form a crotch it is almost certain that one of them will break.

A pair of pruning shears or a sharp pruning knife is sufficient to do all the pruning needed if the work is undertaken in time. The use of a saw is to be discouraged though it is frequently a necessary evil. In making a cut no projecting spur should be left and the wound should be as small as possible, care being taken not to tear or injure the bark. The cut should always have a good slant. Whenever a wound is made with so great a diameter that it will not grow over in one season, it should be painted with something to keep the wood from checking and rotting. Shellac dissolved in alcohol is good, or ordinary paint may be used. To prune intelligently the habit of growth of the tree, whether upright, spreading, or close growing, should be studied. In fact, in practice, it will be found necessary to give every variety of fruit a little different treatment.

Thinning the Fruit.

One of the striking facts in regard to profits in growing prunes, is the much greater net profit in growing prunes of a large size. Net profits are almost doubled by an increase in size. The question as to why prune growers do not *thin* their fruit and get large prunes is constantly suggesting itself. In looking over the records of the Survey taken last year I do not find a dozen men who practice thinning their prunes other than by reducing the wood of the tree by pruning. The best prunes cannot be grown on overloaded trees. The quantity of fruit in bushels will be the same on a tree whether the fruit is thinned or not, and you have for the trouble of thinning a hand-

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somer and much more valuable product. Thinning requires considerable work, but if systematically done it resolves itself in a simple job, and, at any rate, the fruit must be picked sooner or later and the work done in June and July saves just so much work when the crop ripens. From this standpoint, then, it is an extremely shortsighted policy not to thin fruit, but there is another factor which makes the operation still more important.

On trees that have had their fruit thinned there are, of course, many less pits, the large fruits being mostly watery flesh. For the formation of the excessive number of pits in the fruits on unthinned trees it requires a much greater quantity of the mineral elements of the soil and since these are the elements most apt to be wanting and most difficult to obtain it is obvious that the growth of a tree, overloaded with fruit, is checked, its vitality weakened, and in the end productiveness lessened.

During most seasons, on overloaded trees, much of the fruit drops. Had this fruit been taken off at the proper time there would have been a much less strain upon the tree. If properly thinned, the danger from "brown rot" or "plum rot," which has shown itself in the state and which threatens to do considerable damage, will not be so great, since the disease is communicated from fruit to fruit, hence will be worst where the fruit is thickest.

The thinning can be best done when the prunes are about the size of the end of one's thumb, though no set rule can be given for the operation. The quantity removed must vary with the size, and vigor of the tree, the variety, and the way in which the tree has been pruned. When the work is done the fruit should be evenly distributed over the tree, making due allowance for the size and strength of the various branches. With a little experience a tree can be very easily thinned, the prunes being pulled off by handfuls. The work is much facilitated if the tree has been well pruned, since pruning reduces the necessity and makes it easier to get at the fruit on the tree.

Pollination of Prunes.

Within recent years the importance of cross-pollination for some fruits has been clearly demonstrated by several scientific workers. The matter was first brought prominently before horticulturists by Waite* of the Agricultural Department at

*M. B. Waite, U. S. Dept. Agrl., 5th Div. Path.

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Washington in his bulletin on the pollination of pear flowers in which he proved that "many of the common varieties of pears require cross-pollination, being partially or wholly incapable of setting fruit when limited to their own pollen." He also noted that some varietes of apples were sterile to their own pollen. Beach† of the New York Experiment Station found that some of the varieties of grapes need cross-pollination. Of more interest to prune growers are the statements of Bailey‡ of Cornell and the work of Waugh§ of Vermont. The former says that some of our varieties of native plums are not fertile with themselves, and that the "infertility is due to comparative impotency of pollen upon flowers of the same variety rather than to any structural imperfection in the flowers themselves," and that "this infertility is avoided by mixed planting, by means of which foreign pollen is supplied to the impotent varieties." Waugh found that "cross-pollination in plums is provided for by several natural adaptations, especially by the defectiveness of flower parts and by the sterility of certain varieties toward their own pollen." All of this leads up to the question as to whether our prunes, especially the Italian which sets fruit so poorly, would not be benefitted by cross-pollination.

It is a matter of common observation that the Italian for some cause or other, is, in certain locations, or in certain seasons, or under peculiar climatic conditions, a shy bearer. There are reports among fruit-growers that solid blocks of Italians fail to set fruit while in the same locality those in mixed orchards set a full crop. Such reports are not well substantiated, but their being current lends color to the view that cross-pollination, secured by mixed planting, would benefit that variety. Plans were on foot at the Station this spring to determine as far as possible the cause of the variability of the Italian in setting its fruit, but the entire failure of the crop frustrated all plans. The matter is of considerable interest to large growers of prunes and any data or information bearing upon the subject should be given to the public.

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†S. A. Beach, N. Y. State Station Rpt. 1892. Self Pollination of the Grape.

‡L. H. Bailey, Cornell Expt. Sta. Bul. 38, Cultivated Native Plums.

§F. A. Waugh, Vermont Expt Sta. Bul. 53, Pollination of Plums.

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II. Varieties of Prunes*.

AT present there are but three varieties of prunes largely grown in Oregon: the Italian or Fellenberg, the Petite or French or Robe de Sargent, and the Silver or Coe's Golden Drop. By far the major part of these are Italians the Petites being second. Most of the other varieties now grown are sold, when cured, as one or another of these three varieties. All black prunes are sold as Italians; amber ones as Petites; and light colored ones as the Silver. The Italian is the great commercial plum of the Northwest for the reason that it thrives best and because its flavor and large size, as grown in Oregon, enables it to command a slightly better price than the Petite, the commonly accepted standard prune. In good locations, as in the Umpqua and Rogue River valleys, the Petite is largely grown and proves to be a more regular and prolific bearer than the Italian. But in growing the Petite we must enter in direct competition with California which at present is a little to our disadvantage, The Silver when well cured and of

*The distinction between plums and prunes is, that prunes can be successfully cured without removing the pits, the product being firm, sweet and long keeping. There is much confusion in horticultural literature regarding the nomenclature of prunes; nearly all of our prunes are known, by different names, in the East as plums.

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large size, sells for a larger price than either the Italian or the Petite, but it is difficult to grow, hard to cure, and must be bleached; these qualities forbid its being extensively grown.

It must not be inferred that our wants are sufficiently well supplied by the three varieties named above and that there is no need of new varieties. Prune growers are not at all satisfied with the standard prunes now grown, as all of them have bad qualities which are serious drawbacks to their being put upon the market with the highest degree of success. There is a broad field for the introduction of better varieties. This is not strange since the prune industry in Oregon is but a few years old, and since, as a rule, the best varieties of fruits for any locality originate in that locality. We may then look forward to the time when the Italian and Petite will have been relegated to old orchards, and new varieties, natives of the Northwest, will have taken their places. We already have one or two new varieties that promise to equal or surpass our favorite Italian, and if their good qualities do not prove to have been overestimated it is to be hoped their supremacy will soon be established.

In the following descriptions I have included most of the prunes that have been tried in the state, and some that have not, but which, because of their merits in California, we might well try. All prune growers are urged to establish an experimental plot upon which new varieties may be tried. We shall, then, in the course of a few years, be able to profit by our mutual experiences, and the general approval of certain varieties will simply mark the survival of the fittest.

Much valuable information regarding varieties has been obtained from files of the Rural Northwest*. In writing descriptions of some of the older varieties I have freely consulted Wickson† and Downing‡. Special attention has been given to seedlings that have originated in the Northwest, and it is hoped that the descriptions and historical sketches are in the highest degree accurate. The cuts are mostly of old varieties and are from life and photographs. They are inserted chiefly that better comparisons may be made.

*Published in Portland, Oregon, H. M. Williamson, Editor.

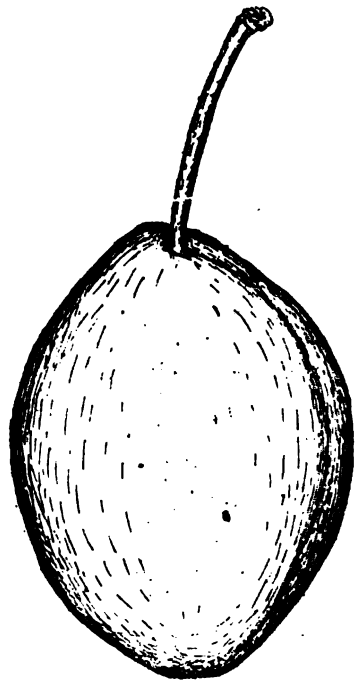
†Downing's Fruits and Fruit Trees of America, Edition of 1888.

‡Wickson's California Fruits, Dewey & Co., San Francisco, Calif.

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Description of Varieties.

THE ITALIAN PRUNE.—*Fellenberg, German Prune, Swiss Prune:*—Medium size or large, roundish but tapering at both ends; suture small but distinct; color, dark purple with a heavy bluish bloom; stalk, 1 inch long; cavity, shallow; flesh, yellowish green, juicy, parting easily from the stone; flavor, sweetish, sub-acid, delicious; tree, hardy, vigorous, very productive; rather late. It is not known where the Italian prune originated, but it has been grown in Italy for a long time, where it finds great favor in the fresh state.



The Italian is at present the leading prune in the Northwest, probably more than four-fifths of the trees in this section being of this variety. Its merits are superiority in size and quality to any other prune grown and superiority in productiveness to all excepting the Petite. When cured it is much larger than the Petite and its sprightly acid flavor makes it more agreeable to the taste for most people. The quality of the Italian prune is such that it bids fair to create a special market for itself, and since it can be well grown only in the Nortwest, possibly when better known to consumers it may command a premium in the markets over other standard prunes.

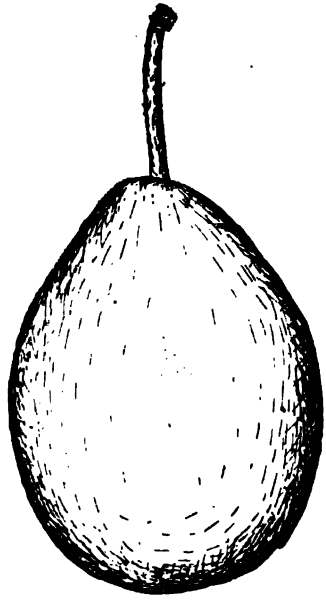
The dried prune is black or bluish black in color and much larger than the Petite or French prune produced in California. Properly cured it has a most agreeable sub-acid flavor. The flesh is so firm that the fruit cures well and after being cured keeps well. The largest sizes of the Italian prune make a most beautiful product and will always bring good prices from customers who buy from appearance as well as quality.

The Italian prune as a plum has been known in the United States for many years. We are indebted to the Rural Northwest for the following regarding its history in Oregon. "The Italian

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prune was first propagated in Oregon about 1857. Mr. Seth Lewelling and the late Henry Miller, both of whom were then engaged in the nursery business at Milwaukee, Oregon, imported Italian stock about that date from Ellwanger and Barry, Rochester, N. Y. So there is a difference of opinion as to which of these gentlemen has the honor of being the first to introduce the Italian."

The Italian prune in the East, or Fellenberg plum as it is known there, has long been considered difficult to grow well. To the contrary, in the Northwest it has been considered quite easy to grow the tree well. But since the Italian prune orchards planted so abundantly a few years ago have come in bearing it is found that it is a comparatively hard matter to grow a good orchard of them. They seem quite susceptible to changes in climatic conditions, are particular about soil, and are preyed upon by diseases and insects to a greater extent than most varieties. This year nearly every Italian prune tree in Oregon has suffered from the curling and withering of the leaves due to causes to be discussed hereafter. All other varieties were in the main exempt from this trouble. This curl-leaf has been present but not prevalent in past years. If in the future it should prove as injurious, and no means be found to stop it, the reputation of the variety as a standard prune for the Northwest, will be greatly endangered.



PETITE PRUNE.—*Prune d' Agen, French prune, Prune d' Ente, Lot d' Ente and Robe de Sergent.*—The fruit as grown in Oregon may be described as follows: Medium sized or small, oval or egg shaped, not uniformly pyriform; suture, small, distinct; color, violet purple with bright colored bloom; stem, short, slender; cavity, small, and shallow; flesh, greenish yellow, sweet, full of sugar, rich and delicious, clinging slightly to the stone. Tree, hardy, strong grower, very productive.

This is the prune most widely grown in the great prune

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growing countries, the favorite in the markets, and is mostly known as Prune d' Agen, excepting in the Northwest where it it is always called the Petite. There are several sub-varieties which differ from the Petite chiefly in size and shape; few, if any, of these sub-varieties are known in Oregon, the differences in the Petite as found here being due to differences in conditions. It is probably true that the Petite as we know it is superior to any of its congeners. Prune nomenclature is further confused through the giving of the name Robe de Sergent, as a synonym for the Petite. The two are much alike and the wr.ter is not sure but what they are the same, at least there is not more difference than there is between the Petite and some of its sub-varieties. The Petite came to California from France about 1856.

We take the following from a prune number of the Rural Northwest regarding its history. "The origin of the prune is unknown. Tradition in France is to the effect that it was introduced into that country by the monks of the Abbey of Clairac near Tonneins. From their gardens it spread into the valleys of the Garonne and Lot. Owing to the recognized value of this variety it was largely propagated by grafting and thus acquired the name "Prune d' ente," which signifies the grafted prune. By far the greater part of the prunes cured in France are of this variety." The Petite was introduced into California by Louis Pellier from Agen, hence is often called the Prune of Agen, Prune d' Agen. It derives its name, Petite, from the fact that Pond's Seedling was introduced into California about the same time and was thought to come from Agen. To distinguish them one was called the Petite, or small prune, and the other the Grosse or large prune. The name Petite still clings to the former, but the latter is commonly known, on the Pacific Coast, as the Hungarian prune. Since it came from France the Petite is often called the French prune. Robe de Sergent is one of its French names.

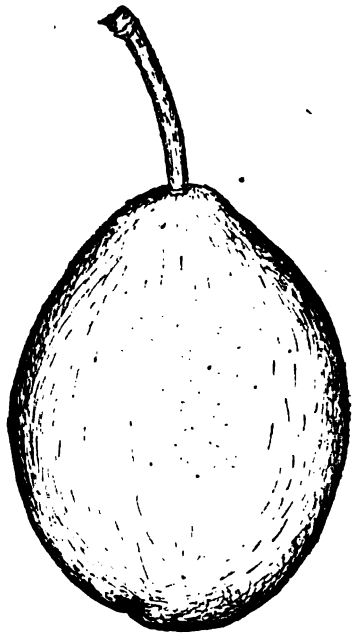
The Petite is smaller than most other varieties of prunes, but has a larger proportion of solids and so shrinks less in curing, thus partly making up for deficiency in size. Its special good good qualities are, its wonderful productiveness, vigor of the tree, ease with which the fruit can be cured, small shrinkage in curing and the surety with which it yields a crop. One of its chief

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defects is its lack of acid which gives it an insipid flavor, though its insipid sweetness recommends it to many. It is of but little value in the fresh state,—in fact is not marketable except as a cured product.

The Petite needs for its best development a warm, rather dry climate, and a rather light, rich, loamy, soil. In Oregon these conditions only prevail in Josephine, Jackson, and part of Douglas county, and in Eastern Oregon along the Snake river and some of its tributaries. Unless grown to a large size the Petite in its cured state is in demand only as a cheap product. The largest sizes, if well cured, will always be in demand as a somewhat fancy product.

SILVER PRUNE.—*Coe's Golden Drop.*—Size, large, oval or roundish; suture, distinct, one side abnormally large oftentimes, necked; color, light yellow in the sun, dotted with small red spots; stalk, stout, nearly one inch long; flesh, yellow, juicy, firm, adhering slightly to a very pointed stone; flavor, rich, sugary, good quality; tree, a precarious grower, but very productive when all conditions are favorable; season, late.



The variety originated with a Mr. Coe in England in the early part of this century and received the name of Coe's Golden Drop. A few years ago it was introduced in the Northwest as a new variety, the Silver, a supposed seedling. Much discussion was engendered because of the close reseimblance to Coe's Golden Drop, and finally led to the appointment of a committee from the State Horticultural Society to investigate the matter. The investigating committee reported that the seedling Silver prune tree was a grafted Coe's Golden Drop plum.

The fruit in the fresh state is large and beautiful and of delicious flavor. The cured product is larger than that of any other variety, ranging in size from 15 to 30 to the pound.

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The prune has a very agreeable sub-acid flavor and is much esteemed where ever known. Notwithstanding the size of the fresh fruit the proportion of sugars and solids is fairly large. Unfortunately public taste demands that a white prune be sulphured, which proves injurious to the flavor so that the quality of the Silver prune as commonly found in the market is generally not so good as the unsulphured product.

The tree in Oregon requires the very best attention and in fact cannot be grown except under most favorable conditions. Good prune soil, good drainage, attention in pruning, cultivation, and pests, are requisites that must be well looked after in order to succeed with the Silver prune. When the fruit sets well on the trees, the crop must be thinned in order to get prunes sufficiently large to make them of value, and to avoid the danger of broken limbs because of too great a load.

The Silver prune cannot be produced cheaply enough to compete successfully with the low priced prunes, but as a fancy product it will always be in demand. It will, therefore, be found a very profitable variety to grow if one has a location highly favorable to the growth of the trees, and will give them the extra care needed to produce a crop of large prunes, and lastly will give them special attention in curing.

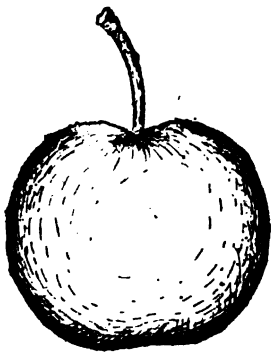
The following taken from a letter written by Mr. W. H. Prettyman, of Mount Tabor, Oregon, tells of the introduction of the variety in the Northwest. It is possible that the so-called Silver is a seedling from Coe's Golden Drop, but if true, the resemblance is so very close to the parent that it serves no purpose, and only multiplies names to distinguish between the two.

"The Silver prune was first discovered in the orchard of Mr. A. L. Alderman, of Dayton, Yamhill, Co., Oregon, by Messrs. Plummer and Spaulding of the Plummer Fruit Evaporator Company. These gentlemen called my attention to it afterwards, got control of the stock, named it the Silver, and engaged me to propagate it. I propagated as many of them as I could for a number of years, but the supply never equaled the demand, the variety being very popular in California. The Silver has proved to be one of the best prunes in quality and leads all others in market value by from one to two cents per pound. The tree is a rapid grower and a very heavy bearer, the latter quality making it short lived unless good care is given and the fruit well thinned."

In Wickson's "California Fruits," Mr. Prettyman is quoted as saying, "The Silver is a seedling from Coe's Golden Drop, which it much resembles,

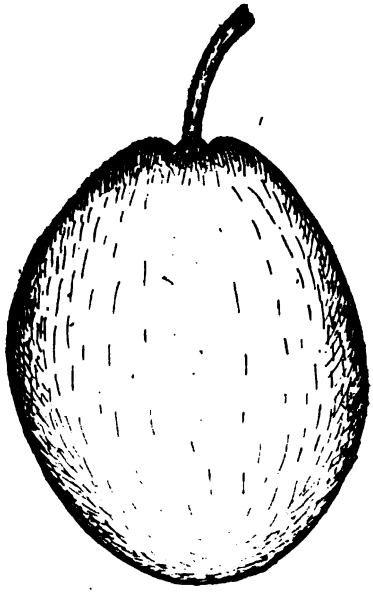
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but it is much more productive; one tree of Silver prune produces more fruit than five of Coe's Golden Drop."



REINE CLAUDE—*Green Gage.*—Fruit, small and round; suture, not well marked, but showing from stalk to apex; color, yellowish green, sometimes, or in the sun or at maturity, slightly marbled with red; stalk, short and slender and inserted in a shallow cavity; flesh, yellowish green, free, juicy, melting; flavor, delicious, mildly acid, sweetish, unsurpassed. Tree of low, slow growing spreading habit; very productive.

The nomenclature of this variety is somewhat mixed from the fact that the trees come fairly true from the seeds, and that there have thus been propagated several varieties very closely resembling the Reine Claude. There is much discussion as to whether our Reine Claude is the Green Gage plum of the East. The writer feels sure that those he has seen in Oregon are the same. For a prune in the fresh state we have no superior, in flavor, to the Reine Claude. In fact wherever it is known it is universally admitted that it has no equal in quality. The Reine Claude should rank equally high as a prune if properly cured. As yet there are but few who have tried to evaporate them in Oregon, but those who have done so pronounce them the most delicious of any of our prunes, claiming that they are equal to choice figs and raisins. The prune if bleached is bright golden, but if not is a dark amber in color.

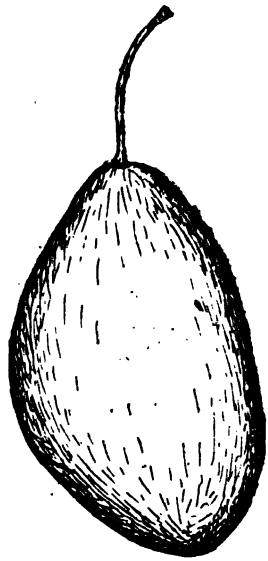


YELLOW EGG.—*White Egg, Magnum Bonum.*—Large, oval, tapering at both ends; suture, very prominent; stalk about an inch long and inserted in a very shallow cavity having a fluted border; flesh, when ripe, of deep

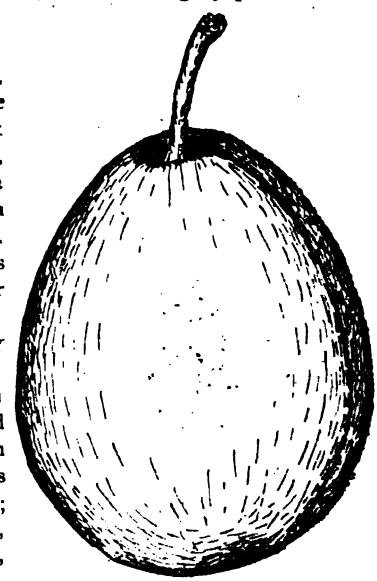
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golden color, dotted with white dots and covered with a thin white bloom; flesh, yellow, clingstone, juicy, quality rather poor, sub-acid or sweetish, coarse grained. Tree fairly vigorous and fairly productive. Chiefly desirable on account of the splendid appearance of the fruit.

GERMAN PRUNE.—A name applied to several varieties of plums and prunes, the name representing a class rather than a variety since the tree comes fairly true from seed. The German prune is a great favorite in Central Europe because of its being easy to propagate and grow. It is an abundant bearer and of fair quality and easy to cure. When prune orchards were first started in Oregon a good many trees of this variety were planted, but because of their being so similar to the Italian, but not equal to it in quality or size, they are not largely planted now.



Fruit, medium size, long, oval, tapering at the ends, swollen on one side; suture very distinct, color, dark purple with a thick blue bloom; stalk, an inch long, slender, inserted in a shallow cavity; flesh, firm and of a greenish color, freestone; flavor good, sub-acid, sweetish. Tree, vigorous and productive. Two weeks earlier than the Italian.



HUNGARIAN. — *Pond's Seedling Grosse Prune d' Agen.*—Fruit, large oval or ovate, tapering at the stem end, and oftentimes having a divided elevated neck; skin, thick and rich in color, sprinkled with brown dots and covered with a thin white bloom; stalk, stout and of medium length, set in a mamelon neck; flesh, yellow, coarse, juicy; quality, rather poor, sweet, but not rich. Tree, a strong grower and prolific bearer. Season,

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two weeks earlier than Italian or about the middle of September.

Introduced into California at an early day and supposed to have come from Agen in France, being contrasted with the Petite Prune d' Agen it was called the Grosse Prune d' Agen. How the name, Hungarian, originated is not known though the variety is best known on the Coast by that name, and so sells in Eastern markets. The plum or prune is of English origin and its true name is Pond's Seedling.

For shipment in the green state the Hungarian is our best prune and is being very largely planted for that purpose, no other prune being as fit as this one for Eastern shipping. Its quality after reaching a distant market is good and its great beauty makes it very desirable in the markets. The trees are vigorous and very productive.

DOSCH.—Hon. Henry E. Dosch, Horticultural commissioner for the 1st district, writes me as follows concerning the prune which bears his name and which originated with him :

"Replying to your favor regarding the Dosch prune ; I beg to say : When I bought my present place, there was an acre of Washington plums grafted on plum roots on the place. On one of these trees grew a sprout which started below the union. The former owner called my attention to it and said that he judged from the dark foliage, large leaves, and immense bud shoulders, that it was a promising seedling, and begged me to leave it. I did so and was agreeably surprised at the beautiful, large, dark purple prunes it yielded.

"Its characteristics are : tree a vigorous, hearty grower, leaves, extra large ; dark purple fruit, covered with a fine light blue plush, and hanging on the tree with great tenacity; shriveling before it will fall off; The prune keeps in good condition three weeks after being picked. When ripe the flesh is a golden green and is very aromatic, semi-freestone. It evaporates 45 lbs. of cured product to 100 lbs. fresh fruit. In flavor it is sweeter than the Italian, but not so sweet as the French. It bears every year and is about ten days earlier than the Italian."

CHAMPION.—Large size, roundish, tapering somewhat at both ends ; suture, well marked ; color, dark purple with reddish bloom ; stalk of medium length rather stout and placed in cavity of medium depth ; flesh, firm, very juicy, parting from the stone easily ; flavor much like the Italian. Trees, very vigorous, healthy, and strong growers. Fruit a month earlier than the Italian. Very productive.

The Champion is one of the most promising of our new prunes for shipping in the fresh state. The vigor of the trees, their productiveness, the size, beauty, quality and earliness of the fruit all recommend it. It is a little too juicy to be very valuable for evaporating. A letter from Mr. C. E. Hoskins following the description of the next variety tells of the origin of the Champion.

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WILLAMETTE PRUNE.—A dark ruddy brown prune of the Italian type. Said to be some larger than the Italian, a little sweeter, a little earlier, and to dry heavier. The dried prune is dark much like the Italian. It requires considerable skill in curing. In the fresh state it is hardly surpassed in quality.

One of the most promising of our new varieties. Mr. C. E. Hoskins, of the Springbrook Fruit Farm, Springbrook, Oregon, the introducer of the Willamette and Champion, writes as follows concerning these two varieties:

"Soon after I came to this state eighteen years ago, I visited Mr. Seth Lewelling, of Milwaukee, Or., Mr. S. A. Clark, of Salem, and Mr. Jesse Bullock, of Oswego, to learn all I could about prune growing. While at Mr. Bullock's, I was given scions of seven new seedlings to test. After fruiting them I reported that in my judgment only No. 1 and No. 6. were worth introducing.

"Mr. Bullock named No. 1 Champion and No. 6 Willamette. The Willamette has since been renamed "Pacific." But I know that they are one and the same fruit, and I have now growing as old a grafted tree of this variety as there is in the state.

"As regards the merits of the Champion and Willamette, especially as compared with the Italian, will say, that I would not recommend the Champion for general planting for evaporating. It will bring as good a price, but is hard to evaporate and will not evaporate so heavy by two pounds in one hundred pounds of green fruit. Its great value is its earliness. It ripens from two to three weeks before the Petite or French. The tree is healthy and a good bearer but does best on valley land, the fruit being small on hill or red land.

"In regard to the Willamette will say that I think it is the best new prune that I have fruited. It is from seven to ten days earlier than the French and is as large or larger than the Silver. The tree is very healthy and bears grandly.

"I find that it gives a larger percentage of cured fruit to fresh fruit than the Italian and it is also a good shipper in the green state. It does well on either hill or valley land."

PACIFIC.—Said to have originated at Mt. Tabor, Oregon. It has the general characteristics of the Willamette and is probably, as Mr. Hoskins says, the same. Those who call it a distinct variety, say that it is larger and more juicy than the Willamette, qualities that would recommend it for shipping in the green state, but not for evaporation,

STEPTOE.—Many good reports come from a new prune called the Steptoe. It has not fruited on the Station grounds nor have we seen the fruit. The following is the substance of a letter written by Mr. Geo. Purdy, of Colfax, Wash, a well known nurseryman in Eastern Washington, the introducer of the variety, telling how the variety originated and giving some of its characteristics:

"The Steptoe prune originated with Mr. Calvin Throop, now dead, many

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years ago on a farm near Steptoe Butte in the Palouse country. Mr. Throop was one of the old settlers in that country and finding that the trees which he imported from the East did not prove hardy he planted pits and seeds of the various fruits. Among the plums of note thus originated was the Throop and the Steptoe prune. My attention was first called to the Steptoe in 1891 when the trees were probably six or seven years old and had been bearing two or three years. The Steptoe tree is an upright, thrifty, grower, bearing every year. The fruit resembles the Italian very much, but is nearly, if not quite, one-third larger. The Steptoe ripens fully two weeks earlier than the Italian which does not always reach maturity in Eastern Washington. Fruit cured in a steam evaporator was said to be a much finer product than that from the Italian. I am confident that in a climate and soil suited for growing prunes the Steptoe will outrank the Italian in every way. But few of the trees have been distributed as yet."

TENNANT.—A prune of the Italian type, which originated with Rev. John Tennant, of Ferndale, Washington. Its most commendable quality is that it ripens much earlier than the Italian, its season being as early as any of our earliest prunes. In Washington it is being planted quite extensively and there are a number of plantations of the Tennant in Oregon. As yet not enough trees have come in bearing in this state so that the variety can be assigned a place.

The following varieties are grown in California, but have not yet been generally introduced into Oregon. Some of them might prove profitable in this state. Descriptions of the first three varieties are taken from Wickson's "California Fruits."

BULGARIAN.—"Fruit, above medium size, almost round, dark purple; sweet and rich with pleasant acid flavor; tree a vigorous grower and an early, regular, and profuse bearer."—*John Rock*. "As prolific a bearer as the Petite prune, but holds its size with a heavy load of fruit much better. The tree is a little more vigorous grower and forms a larger tree and bears its fruit more in the center. Closely resembles the Fellenberg or Italian prune in form and size, but it is not so large. It is rich and sweet when cured. It is not a freestone, but on some soils and in some seasons it has a tendency to loosen from the pit."—*W. H. Jessup*.

ST. MARTIN'S QUETCHE.—"Size, medium, ovate, broadest at base; surface pale yellow often spotted with brown; bloom, white; flesh, yellowish, very juicy, rich, excellent; ripens late and keeps long; tree, hardy and a good bearer; shoots smooth. Approved in Santa Cruz County."

TRAGEDY PRUNE.—"Originated with Mr. Rumyon, near Courtland, Sacramento Co., California. Introduced by W. R. Strong & Co.; appears to be a cross between German prune and Purple Duane; medium size, nearly as large as Duane, and looks much like it, except that it is more elongated; skin, dark purple; flesh, yellowish green, very rich and sweet, parts readily from the pit; ripens in June. The first large plum to ripen; very fine, and valuable for Eastern shipment."—*L. W. Buck*.

GIANT.—One of Burbank's seedlings. A cross between the Petite and Pond's Seedling or the Hungarian. Fruit large size, larger than Pond's Seedling; in color, dark crimson upon yellow background; flesh, rich yellow; texture, fine; freestone; quality, good, sweet and rich; season about

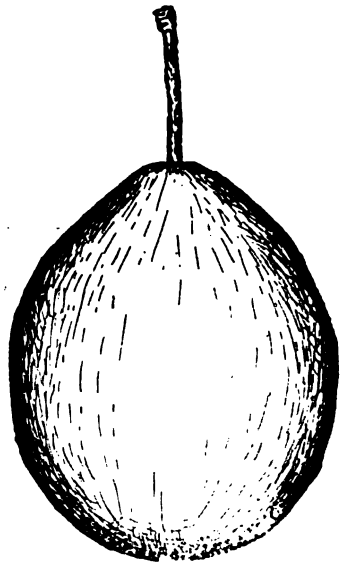
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that of the Petite. Said to be easy to cure and to make a beautiful product. Well worth trying in Oregon.

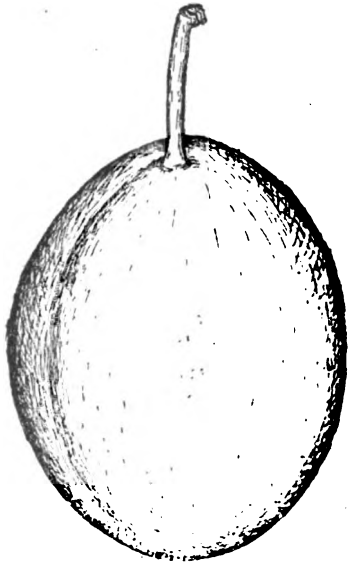
BRIGNOLE.—The variety used in making the famous Brignole prunes of France. Introduced from Brignole. Medium size, oblong; color pale yellow with a reddish cheek in the sun; flesh, yellowish and of good texture; rich and sweet; cures well. Trees vigorous and productive in California.

DATTE DE HUNGRIE.—The date prune of Hungary. Size, large; skin dark purple, covered with a whitish bloom; flesh, greenish yellow, firm, with a very rich flavor; cures well and makes a good product.

ST. CATHERINE.—Medium size; obovate growing small toward the stem; suture, well marked; stalk, long and slender, inserted in a shallow cavity; color, greenish yellow with thin white bloom, occasionally with a blush on the sunny side; flesh, yellow, moderately firm, juicy, semicling; flavor, sub-acid, rich, aromatic, good; season, about that of the Petite—middle of September. Tree, upright, vigorous, prolific.



One of the oldest of our cultivated prunes, not much grown in Oregon, locally popular in California. In France it is much esteemed and it is greatly used in making a superior product of prunes.



WANGENHEIM.—A variety very popular in Germay now grown to some extent in California. Fruit of medium size, oval; color, dark purple, covered with heavy blue bloom; suture well marked, but shallow; stalk, short and stout; cavity small and shallow; flesh, firm, greenish yellow, juicy, freestone; flavor, good, sugary, rich; season, early, two weeks before the Petite, or the latter part of August.

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III. Curing Prunes.

TO SERVE the present age, adequately expresses the purpose which prompts the writing of this chapter. Curing prunes in Oregon is yet in a state of evolution and anything said about it must be considered tentative and not conclusive. It is only hoped then that the best methods now known are presented in this chapter. Most of the information given has been obtained from successful prune growers of the state and therefore has the merit of being practical.

Our method of curing prunes is peculiar to the Pacific Northwest. In Europe the prunes are cooked in the process of curing; in California they are cured by exposing to the sun and wind; in Oregon and Washington we cure them by evaporating the surplus water from them in evaporators. We have only our own experience to guide us and our own inventions to work with. There is therefore a broad field for the origination of better methods and the invention of better apparatus, so that the process of curing may be cheapened and a better and more uniform product produced.

Definitions.

In takes an intelligent person some time to learn the meaning of the somewhat technical phrases commonly used in the prune industry. We therefore give the definition of those most current. Some of the words defined are colloquialisms, but most of them are common to the trade.

Bleaching.—The process of changing the dark color of prunes to a lighter hue; generally accomplished by sulphuring.

Bloaters. Prunes which in drying swell up to an abnormal size. The swelling is supposed to be caused by fermentation which produces a gas. Bloaters are generally produced from large, soft, overripe prunes.

Dipping.—A process of cleansing and cutting the skin of fresh prunes preparatory to putting in the evaporator, in which the fruit is submerged in boiling lye, made by using one can of concentrated lye to fifteen gallons of water. Cured prunes are also sometimes dipped in glycerin and water,—one pound of glycerin to 20 gallons of water, which improves their appearance and adds

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to their weight and keeping qualities.

Drip.—The syrupy liquid which oozes from prunes in the process of curing; it generally characterizes a poor prune or a poor evaporator. As a verb, the falling of the drip.

Extras.—A superior quality of prunes; generally referring to size.

Frogs.—Small, poorly developed prunes having an abnormal shape. Not a synonym of bloaters. Supposed to be caused by unripe fruit, poor soil, or any unhealthy conditions of the tree.

Grading.—Separation of prunes either before or after curing in uniform sizes.

Pricking.—The process of puncturing the cuticle of the fresh prune preparatory to putting in the evaporator. Pricking is done by means of a machine the essential part of which is a board covered with projecting needles over which the prunes must pass. A substitute for lye dipping.

Sizes.—The number of cured prunes it takes to make one pound. Those requiring from 40–50 prunes to weigh a pound are called 40s–50s; those requiring 50–60, 50s–60s, etc. The "Four Sizes," are the 60s–70s, 70s–80s, 80s–90s, and 90s–100s; commercially, it means equal quantities of these sizes. Sizes and grades are used as synonyms.

Sugaring.—The formation of globules of sugar upon the cuticle of cured prunes rendering them syrupy and sticky and destroying the lustre of the prune.

Sulphuring.—A process cured prunes are put through to give them a lighter color. The prunes are put in a tight room, generally just as they are put on trays before being placed in the evaporator, and subjected to the fumes of burning sulphur for a half hour. Or they may be sulphured after being taken from the evaporator.

Sweating.—A process prunes are subjected to, immediately after being taken from the evaporator, in which they are put in piles or bins with the temperature at from 70° or 80°, turned several times, and allowed to sweat.

Picking and Grading.

There are all sorts of prunes put upon the market. The differences are largely attributable to the care and attention given to the details of curing. Simple as it may seem the picking of the

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fruit is one of the very most important matters in the processs of curing prunes. Half the "bad luck" attending evaporation, in which frogs, bloaters, sugared fruit, and drip, are produced, is caused by carelessness in picking. We put the greatest emphasis upon this as neglect in picking is one of the commonest faults in prune making, and its betterment must be recognized as a fundamental requisite of success. I have seen men knocking the fruit from the trees with clubs, handling it with shovels, and pouring it roughly from boxes in a wagon bed. "There is nothing in prunes," was the cry when the product was put on the market.

Shortly before the picking season begins the ground under the trees should be cleared of rubbish and worthless fruit and the soil mellowed with a steel rake. The Petite prune, and to a large extent the Italian and other varieties, when ripe enough to dry will drop to the ground, at least no further assistance is given it in falling, than a gentle shake of the tree. If the fruit shrivels a little before dropping, all the better. The object in thus letting the fruit get *thoroughly ripe*, is: that not until then, is there a maximum amount of solids and saccharine matter so desirable in a good, cured prune; much drip is prevented since there is less juice; and the essential rich flavor is not present until the fruit is ripe.

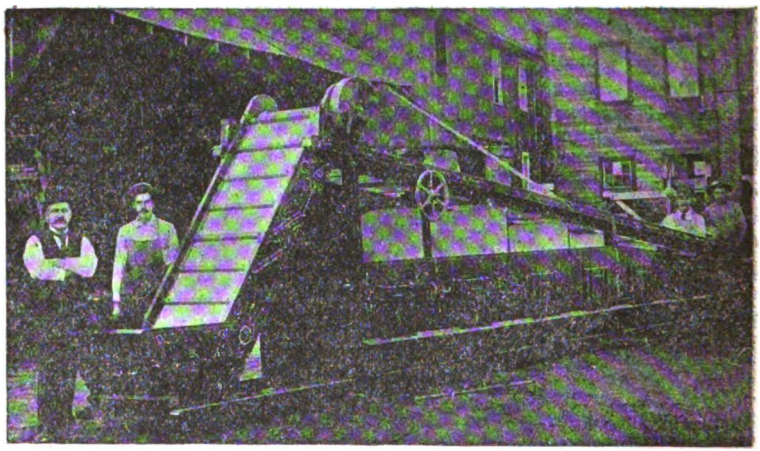
In picking properly, the orchard must be gone over several times, the number depending upon the rapidity with which the fruit ripens. If shaking must be resorted to, labor can be saved by placing a sheet on the ground under the tree and the ripe fruit shaken into it after which it can be turned into boxes. At all times the prunes ought to be carefully handled to avoid breaking the skin thus causing the prune to drip or sugar in the evaporator, and allowing germs to enter to cause fermentation and consequent bloaters and frogs.

Prunes ought to be graded both before and after drying. Before drying in order to remove twigs, leaves, and rubbish, and to attain equality in drying, since the smaller fruit will of course dry more rapidly than the larger. As it comes from the orchard the fruit should be graded in three sizes to insure perfect uniformity in evaporation.

A number of machines and contrivances are used to do the

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work. Without doubt it is best and cheapest in the long run to get one of the many excellent graders now on the market. These work on various principles, one of the commonest of which is an inclined plane with adjustable slats or screens allowing the large fruits to roll into receptacles at the bottom, while the small fruits fall through into other receptacles before reaching the bottom. One is made with wire screens of different size of mesh arranged as in a fanning-mill, each screen with a spout on the side where each grade drops into a box. All graders should have a screen so small that only dirt and stems can drop through. A good grader ought to be available for grading prunes both before and after drying.

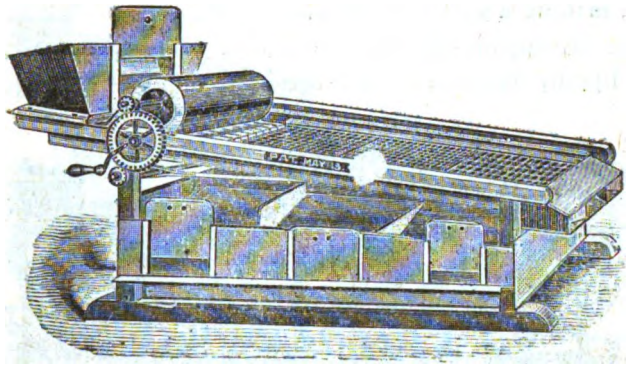


The accompanying cuts show typical graders. The first one is a steam power machine with a capacity of seventy-five tons per day. There is much saving in having in connection with a large plant, all machinery run by steam power. The second cut shows a hand grader with a capacity of forty tons per day. Either of the two graders may be used before or after evaporating. Both are Hamilton graders.

Cured fruit is generally graded just after it has finished sweating. There are usually several sizes in each variety. The price varies from about one-sixth to one-tenth cent per size. The Silver will grade highest by two or three sizes, the Italian second, by three or four sizes higher than the Petite. Commission men

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often prefer to do their own grading; the fruit in this case being taken directly from the evaporator to the warehouse. Proper



grading is a very important step in the industry, the way in which it is done having much to do with profit or loss.

Dipping Versus Pricking.

Prunes are dipped in boiling lye, or pricked by needles in a pricking machine, to check and make tender the tough skin so that the moisture can escape easily and drying be thus facilitated. Incidentally the fruit is cleansed. Both processes are in vogue and a discussion of their relative merits is in order.

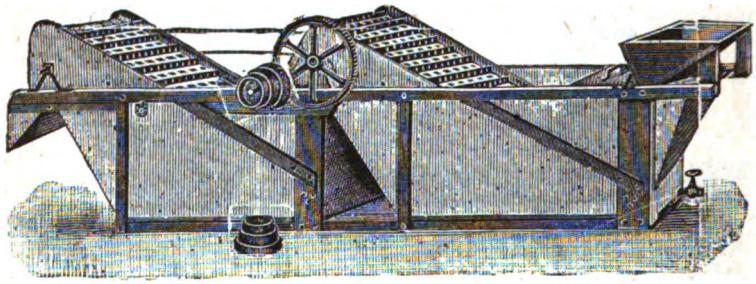
Lye-dipping, as practiced in Oregon, is about as follows: One pound of concentrated lye is dissolved in from 10 to 50 gallons of water, the proportion of lye and water differing greatly with the various prune growers. The primitive way, is to keep the solution boiling in a large kettle, into which the prunes, placed in a wire basket or a much perforated metal vessel, are immersed and there kept in motion, by twirling or swinging, for from 30 to 60 seconds, depending upon the condition of the fruit. A more modern way is to have the fruit run from the grader to a set of endless chains with carrying aprons and by them carried through a pan containing the boiling lye solution, heated with submerged steam pipes; from the lye the prunes are carried on through fresh water, preferably running water, and then spread on trays.

If the operation is well done the prunes on coming to the trays should have their skins bright and shining and present upon close

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examination a finely checked condition. Over or under immersion causes the fruits to dry unevenly; when too much scalded the skin tears and becomes ragged and the fruit beomes soft and mushy, making a sticky, nasty mess on the trays.

The accompanying line cut shows a Cunningham steam power dipping machine. The machine may be attached to a



grader and spreader, thereby enabling the grading, dipping and spreading to be done in one operation. There are a number of these machines in use in Oregon.

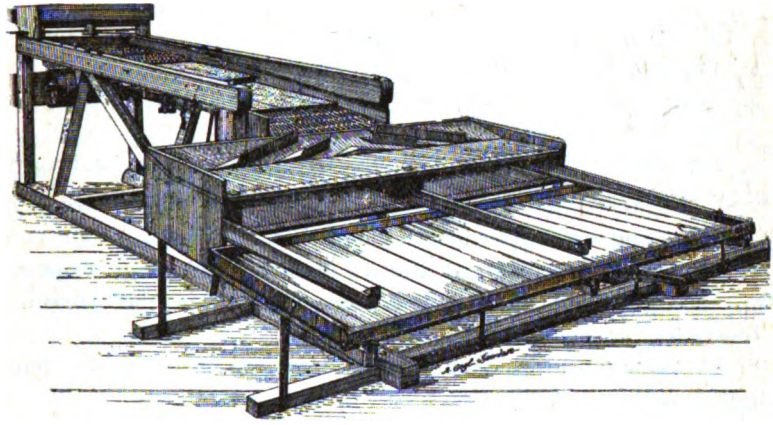
Pricking machines mechanically cut or perforate the skins of prunes. The fruit is fed over a shaking table that has needle points projecting above the surface, these cut and perforate the skins of the prunes. The needle table can be regulated so that by having different slants the skins may be cut more or less, as the condition of the fruit requires. The dirt and leaves are separated by a sceen and the fruit is washed either by having it pass through hot or cold water, or by having a stream of water play on the fruit as it comes on the pricking table. The pricking machine may have grading and spreading attachments so that the fruit, from the time it is poured from boxes need not be handled until on the drying trays.

Each of the two methods are championed by experienced and practical men, some of whom have tried both, and seemingly have obtained directly opposite results. We must then come to the conclusion that a choice between the two methods rests either upon prejudice or that there is a place for both, depending upon the product desired or the fruit that is to be handled.

The illustration shows the Burrell power pricking machine

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with grader and spreader, capacity fifty tons per day. This machine has a device by which the pitch of the needle board



may be changed while the machine is in motion. Hand pricking machines or larger power machines are made.

A discussion of the good and bad points of the two methods probably will not make converts among many of those who have already formed their opinions, but it may enable those who are beginning in this phase of the industry, if they think it necessary to either dip or prick, to make a choice. Right here it may be well to say that lye-dipping has by far more advocates in Oregon than the pricking,—the latter process being comparatively new in this state.

The chief objections to lye-dipping are:

1. It is a nasty process as generally practiced. Without the most scrupulous care, lye, over-dipped prunes, and the drippings and scum, accumulate, produce foul odors, and attract insects.

2. It is unsystematic and unscientific. Scarcely any two men use the same amount of lye, or dip the same length of time, and since several brands of lye are used the strength of a solution is uncertain.

3. It takes in every case a most experienced man to tell whether the operation is rightly done, whether the prunes are dipped enough or over dipped. These three objections, I must admit, do not mitigate against the use of lye, but rather

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the abuse of the process. A more important objection is :

4. Lye-dipping, because of cost of fuel, material and labor, is expensive.

The points in favor of lye-dipping are :

1. The prunes are generally better cleansed.
2. Their evaporation is hastened to a greater extent.
3. The skin is rendered less tough.
4, For those who desire a finely wrinkled skin and a bright amber color, lye-dipping gives the prunes a better appearance.

The chief objections to pricking are :

1. The great object sought, that of facilitating drying, is not so well accomplished as by lye-dipping. This is the greatest objection.
2. In evaporation pricked prunes drip and sugar more than dipped ones.
3. A very current objection, which has but little foundation, is that the needles break off in the prunes. They rarely do in a good machine.
4. Another current objection is, that the flavor is not so good as in the dipped prunes. The difference in flavor in dipped and pricked prunes is inconsiderable and may be to the advantage of either according to one's taste ; it cuts no figure in the markets. It is true that the skin is a little tougher on the pricked prunes.

The special good points are :

1. That the process is cheaper, notwithstanding it takes longer to evaporate pricked prunes.
2. Pricking is more cleanly and systematic.
3. The prunes dry more evenly and there are less frogs and bloaters produced.
4. For those who like a shiny, black, smooth prune, the appearance is better.

In conclusion, it may be said, that both processes, have a place in the prune industry. The choice of method must depend largely upon, the special conditions of fruit, congeniality of either the one or the other to the operator, and the appearance of the prunes that the producer likes best. It may be that the consumer's or the buyer's taste will eventually have something to do with settling the question.

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Final Processes.

After dipping, or pricking, the prunes are ready for the evaporating chamber. It is impossible to give detailed directions for treatment in the evaporator, since the process must necessarily vary with the character of the evaporator.

But, in general, in evaporators which have an ample circulation of air, the temprature should be about 120° to 140° at the start to be gradually increased to 160° to 180° when the fruit is taken out. Too much heat at first, causes the fruit cells and consequently the fruit to expand and burst, then the prunes drip. Too high a heat, by cooking the fruit, also hinders chemical changes and causes discoloration. In evaporating where the temperature greatly decreases with the distance from the furnace, the fruit should be placed in the coolest part of the evaporating chamber and then gradually be moved to the warmest part.

The time required for drying prunes differs with various varieties, and with each variety depends much upon the circulation of air, since circulation governs the degree of heat allowable. Lye-dipped Italian prunes require from 24 to 36 hours; Petites, 12 to 24; Silvers, 36 to 48 hours. All three varieties are cured in less time, but seldom well cured. A common fault is to hasten the process too much.

There are other factors entering into the process of evaporation,—such as circulation of air, convenience in handling, trays, labor, fuel, etc., but these will be considered under the head of evaporators.

A prune is well cured when it feels soft, smooth, and spongy; the pit should be loose, but should not rattle; the flesh should be yellow in color, elastic and "meaty," the skin should be bright and lively aud free from drippings and exudations. An over-cured prune is harsh and coarse and has a dried up appearance. In prunes not cured enough there is risk of loss through molding or fermenting. The Petite prune, well cured, is of a clean, bright, amber color; the Italian, very dark red, appraching black, in color. The Silver must have a beautiful golden hue. This brings us to the matter of sulphuring.

All light colored prunes must be bleached with sulphur fumes. This process without doubt injures the quality of the prunes, but buyers will have to be educated to see this before

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they will pay as good a price for the unsulphured prunes as for the lighter colored sulphured ones. Until this time comes the producer cannot do otherwise than make use of a process which adds from one to two cents per pound to the value of his product. Only fresh fruit, just before going into the evaporator, should be sulphured. The rejuvenating of old, discolored, cured prunes, has no legitimate place in the prune industry.

The process of sulphuring is an easy one. The most common method is to build a chamber about six feet high, and as wide and a little deeper than the tray. On the sides of the chamber are cleats which allow the trays to be easily slipped in and out. The door occupies all of the front side. In placing the trays in the chamber, alternately leave a space at the back, and at the front, so the sulphur fumes will pass back and forward over the the trays. The sulphur is put in a metal vessel in a pit at the bottom of the chamber and ignited by hot coals or other burning material. The fumes are distributed by means of simple ventilators at the bottom and top of the room, after which all openings are closed and the fruit allowed to be affected rom one to two hours. The chamber should be nearly air tight. The trays of fruit are transferred directly from the sulphuring room to the evaporator where the sulphur is expelled by heat, its poisonous effects being thus reduced to the minimum.

After the fruit is taken from the evaporators it is put in bins or piles to sweat. The sweating room is generally kept at a temperature of from 70 to 80 degrees. To facilitate the process the fruit is occasionly turned with a scoop shovel. The sweating is sometimes omitted, but at a risk, as fruit will oftentimes discolor and possibly ferment if not alllowed to "go through the sweat."

Preparatory to packing, the fruit is graded to sizes, the various grades indicating the number of prunes to the pound, as 30s to 40s, 40s to 50s and so on to 110s to 120s. By some the prunes are dipped in boiling water and glycerin, or other solutions, but such dipping is in disrepute as indicating an undue amount avarice to secure weight. However, intelligently done, "glossing" or "finishing" prunes, may be made a valuable process.

In packing, many different methods are used. A producer will adopt which ever one for his particular reason, or his partic-

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ular market or conditions, will give him best results. Only experience can teach this. Much fruit is packed in cotton sacks, many buyers preferring it so packed as it gives a chance for repacking. Producers with a good product like to establish a reputation for their brands and so pack in boxes. There is a gain in weight by this method as the fruit does not dry out so much as in the sacks.

Packing fruit is an art and must be learned by observation. Lining with paper, filling, facing, etc., all require a little education. If the boxes are to be faced, average specimens of prunes should be flattened and neatly laid in the box which should be upside down. Fill the box, press, nail on the bottom, invert, and brand, or put on the label.

IV. Evaporators.

THE MOST important question prune growers have to deal with at the present time, is that of securing good evaporators. Those who have built evaporators are not satisfied with them; those who intend to build cannot find one that suits them. Men have been stumbling rather blindly about since the beginning of the prune industry in Oregon hoping to bring forth and invention that would meet all requirements for making a good product. But no one has been eminently successful. It is true that great progress has been made, and much valuable experience gained; so much, in fact, has been accomplished, in a short time, that we can quite confidently look forward to the evolvement in the near future of evaporators of very superior excellence to those now in use.

The following chapter is published, not with a view of adding to what is already known about evaporators, or of making suggestions for their improvement, but to bring before the prune-growers descriptions of the types we already have that they may choose more intelligently if they intend to build, or study more carefully if they think of making improvements upon evaporators they now have.

The importance of the erection of better evaporating plants, and more efficient management of them, can hardly be over-

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estimated. A good evaporator is the prime essential to success, not only for the individual but for the industry; if, for no other reason, than, that there is at present, such a wide range in the quality and style of our product that it has no established place in the markets, in consequence of which we lose much, buyers always preferring fruit with a good reputation. This would be largely overcome if we had standard evaporators producing, necessarily, a more uniform product.

In connection with this subject we are glad to publish the following from Hon. Henry E. Dosch, Horticultural Commissioner for the 1st District, who has had much experience with evaporators and with the evaporation of fruit.

Evaporators and Fruit Evaporation.

The construction of evaporators on correct principles and the art of evaporating fruit, has engrossed the minds of scientists and layman alike, both at home and abroad, and it seems as yet, we have not reached the wished for goal, but we are on a fair way to it.

To dry fruit is one thing, but to evaporate it, quite another,—simply to put a lot of fruit on a tray, put it into an oven, fire up and wait until it has shriveled away to a bony state, almost any one can do; but to properly "evaporate" fruit, so it is a fine marketable article, requires a good deal of care and intelligence on the part of the operator. It is in this, like in all other business or trades; the principles involved, must be thoroughly understood, in fact the operator must be educated to it, the same as any master mechanic.

The two great principles involved are heat and circulation: without these two, it is useless to attempt to make good fruit—It cannot be done.—And it matters little whether the heat is supplied by a brick furnace with large radiating pipes or by coils of steam pipes, so long as it can be controlled; for remember hot air in space is a very different thing to control, and can only be accomplished in a properly constructed evaporator with thorough circulation.

I have experimented for many years in fruit evaparation in variously constructed evaporators and we have made rapid strides forward, and as I said, while we have not yet reached our goal, we are very close to the line. I will not attempt to describe the many patented and non-patented evaporators, all of which have good points, and while some operators can make fair fruit on any of them, none are yet perfect.

My own experience however has led me to the conclusion; that all fruits must be started at a low heat and finished at a high heat, in order to prevent the loss of the aromatic juices and fruit meats, essential to fine fruits and in order to accomplish this, the evaporator must be so constructed, that the trays of fresh fruits are placed in, furthest from, and be made to gradually advance toward the furnace or steam pipes. There ar

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now two evaporators made in Oregon, in which this principle is employed, but it is hardly proper for me to recommend any particular evaporator.

The dipping in lye solutions, so objectionable to consumers of refined taste must be done away with. Thanks to Prof. Hoersch Durren, this is no longer necessary as fruits "steamed" prior to evaporation, make a much finer product. He says, "it will open the pores of the skin to facilitate evaporation and prevent dipping; it makes the skin tender and eliminates that leathery substance found in most of our dried French prunes; it requires less heat and "*fruit will dry heavier or more meaty*" than unsteamed fruit." This alone is a strong recommendation and worth all the trouble and expense; the pressure in the steam box should not be over ⅛ pound; prunes to be subjected from 10 to 15 minutes; pears 15 to 20 minutes; and apples 1½ to 2 minutes, and on removal immediately transferred to the evaporator.

Experiments made recently by Mr. Adam Fleckenstein in his new evaporator, in which both the foregoing principles were introduced, proved decidedly successful; French prunes yield 45 pounds to the hundred, and Italians 33 pounds of evaporated product to 100 pounds of fresh fruit.

Rapid evaporation as claimed by some patentees as a point of merit, is a great mistake; nature if left to her good offices, will dry fruit very slowly in order to develop the saccharine matter, and the closer we follow her, the nearer right we are; nature makes no mistakes; French prunes should never be evaporated in less than 24 to 30 hours; Italian and Silver prunes 36 to 42 hours; apples in 6 hours; peeled pears in 24 hours and unpeeled pears 48 to 60 hours.

I hardly think it necessary to add, that all prunes must be dead ripe.

HENRY E. DOSCH.

Kiln and Box Evaporators.

The first prunes produced in Oregon, were, if I am rightly informed, evaporated in a kiln, or as we commonly know it, a hop drier. The essential parts of which were, a room with a slatted floor underneath which heat was produced by a furnace. It was a primitive affair and has long since been relegated to the past in the prune industry. The kiln was followed by the box evaporator an evaporator still in use and from which, when well operated, oftentimes a product is turned out which is indistinguishable from that produced in the best patent evaporators. In box evaporators the fruit is placed upon trays which are arranged in rows in an upper room or division of the building, the furnace being in the lower division. Various contrivances, depending upon the ingenuity of the builder, furnish ventilation and a draught for carrying off moisture laden air. The particular merit of the box exaporator is its simplicity and cheapness.

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The Steam Evaporator.

The steam evaporator is a modified box evaporator. The trays are arranged in tiers; under and above each tray or two trays, is a coil of steam pipes, several runs in each coil. Narrow horizontal doors allow of the insertion of trays, and enable the operator to examine or handle fruit without regard to other trays. These alternate tiers of pipes and trays are of a convenient height for a man to reach, or they may extend through two stories. In width, the evaporator will only allow, conveniently, two trays to be placed side by side, but in length the number is limited only by economy in laying pipes for heating. At the top of the tiers, a very large shaft, or a number of smaller ones carry off the moisture laden air; openings at the bottom allow an inflow of air. The main defect of all steam evaporators coming under the writer's observation is, that poor ventilation causes excessive drip. We believe that the man who solves the problem of building a steam evaporator on the general plan outlined above, in which the moisture laden air can be carried off, so that fruit will not drip, will solve the problem of getting a good evaporator. Good work is being done in several large steam evaporators in the Northwest.

Without question, for a large plant, heating by steam is the most efficient and economical method; this is particularly true because in such a plant power is wanted for running graders, dippers, elevators, and pumping water.

The Carson Evaporator.

The Carson evaporator is a patented, modified, box, evaporator, its particular merit is an ingenious method for securing good ventilation. The Carson is used, perhaps, more than any other one evaporator in Oregon. It is sometimes built in a modified form to overcome an inconvenient way of handling the trays of fruit. Plate III shows a cross section of a pair of Carson evaporators.

The evaporator may be built of various sizes, but the usual size is 18.5 × 8 feet, such an evaporator has a capacity of 5000 pounds of ripe fruit per day. The lower part of the building consists of a furnace room, built of brick, and contains a furnace in each end. The walls of the furnace are 8 inches thick and 16

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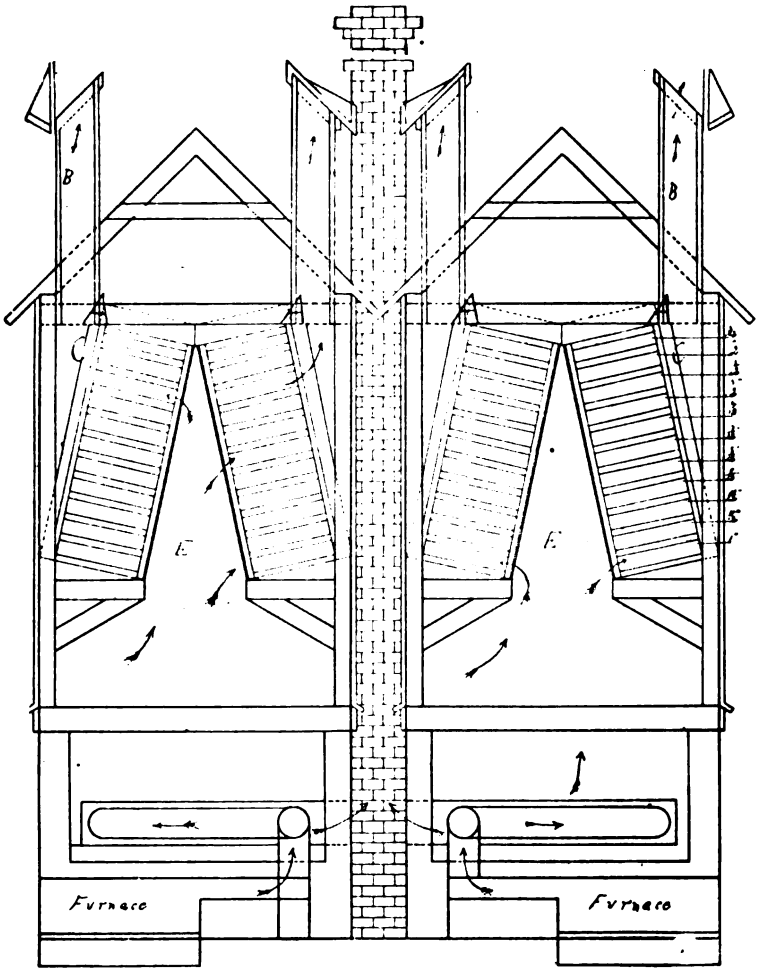


PLATE III. THE CARSON EVAPORATOR.

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inches high, and are connected by an arch made of one thickness of brick. Care in regard to material and workmanship must be exercised in order to prevent danger from fire. Two 10 inch pipes carry the effects of combustion from the furnaces and discharge them in a 12 inch pipe, which passes through the wall of the room into a brick chimney, situated at the side and center of the evaporator. At the connection of the small pipes with the large one, each of the small ones has a damper; as it passes in the chimney the large pipe has a damper. These dampers give the operator full control of the temperature.

Cold air is admitted to the furnace-room at the bottom of the walls. It is necessary to admit a large volume in order to create sufficient draught to carry off the moisture from the fruit. The draught is created by this air becoming heated and passing out through ventilators at the top of the building.

In the cross-section shown in Plate III it is seen that the frames for holding the trays incline inward toward the top of each dryer. The frames being thus arranged allow open spaces between the trays and evaporator walls; the outer edge of each tray is 7 inches higher than the inner edge. The space, E contains hot air from the furnace below; the room is tightly ceiled from A to A so that air cannot pass from one side to the other. On the inclined frame, at the uppper edge of each tray, represented in the illustration by one inch, eleven-twelfth inch, ten-twelfth inch, etc. are graduated cracks, running the whole length of the evaporator; these cracks open into the hollow wall, C, between the tray frames and evaporator walls. The cracks are graduated so as to overcome by draught the tendency of the hot air to rise to the top of the room. At the top of the hollow space there are on each side, five up-take ventilators shown by B, 12 × 12 inches and 6 feet high. These remove the humid air from the hollow wall. Each up-take has a cover working on a hinge, by means of which the circulation of air is controlled.

The philosophy of this plan of ventilating is, that the hot air in space E is carried above and below each tray and through the graduated cracks into the space between the tray frames and the wall and out through the up-take ventilators. The arrows indicate the direction air will take from the time it comes in until it goes out. Thus the humid air from the lower trays passes out without oppor-

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tunity to condense and settle upon fruit in the upper trays, causing drip and hindering the proper chemical changes from a green prune into a first-class cured prune.

The Carson evaporator has several points of excellence: its cost is small; there is no machinery to get out of repair; it is easily operated; any good mechanic can build it; and the expense for heating is reduced to the minimum. One objection to the evaporator, offered by many, is that it is inconvenient to place all of the trays in the drying chamber from the ends; this has been remedied by several builders by having doors on the sides. For a large plant, steam pipes may be used instead of a furnace for heating.

The Penniman Evaporator.

The Penniman evaporator is an ingenious invention in which the trays of fruit are placed on a sort of Ferris Wheel and forced through the heat. The essential features of the evaporator can be readily seen in the accompanying cut.

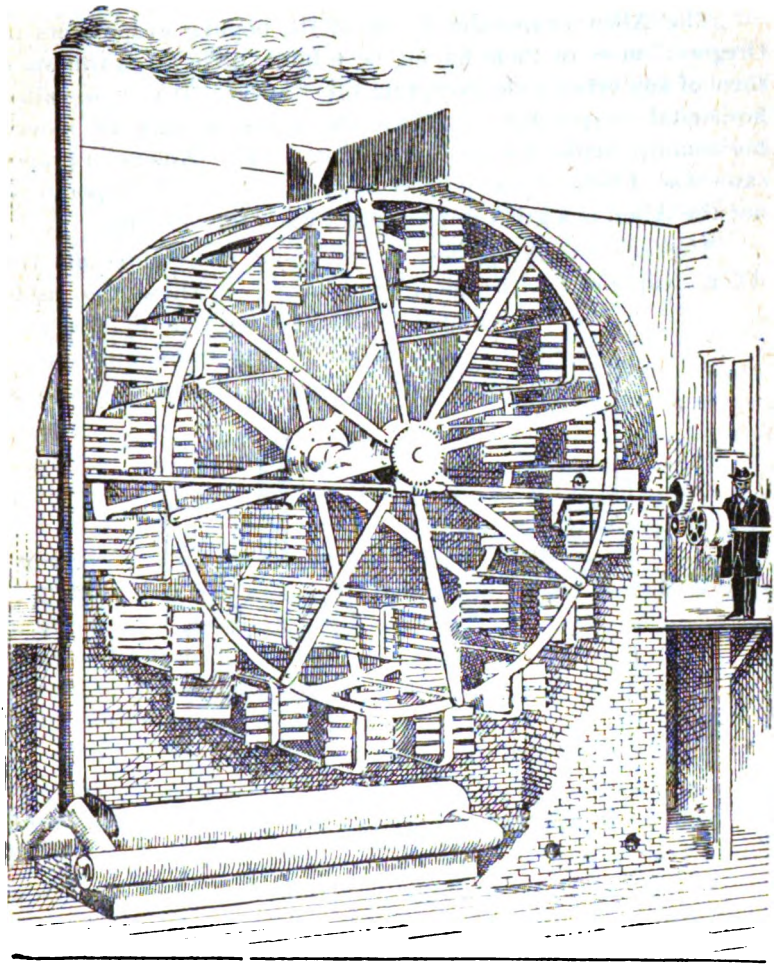
A narrow, arched, brick building forms the evaporating chamber; a furnace at the bottom of the chamber furnishes heat; a revolving shaft in bearings, is mounted in the side walls above the furnace. Two large wheels, their rims united with rods, are fitted to the shaft. Hangers, with a series of transverse crossways to hold the trays of fruit, are loosely attached to the cross bars; the trays are thus maintained in a horizontal position at all times simply by the law of gravity. The trays are put in place through a door at the front, the wheel being slowly rotated by hand. The fruit may be examined, in the process of evaporation, by opening the door or through windows in the upper part of the building. The system of flues, drums, and dampers, is ingeniously arranged to regulate heat. Ventilators admit cold air below and permit heated, moisture-laden air to escape above.

In the process of drying, the fruit is first subjected to a high heat, being on the bottom of the wheel, but as evaporation progresses it is carried to the cooler upper part. At the end of the revolution of the wheel the evaporation is finished. A simple device of cogs and a shaft enables the operator to turn the wheel. Various sizes of the evaporator are made. In the one shown in the cut the diameter of the wheel is 14 feet; the space between the rims, 6 feet. There are 24 hangers each containing 5 trays,

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the trays being 5 × 2 feet, making a spreading surface of 1200 square feet. The makers claim that its capacity is from 6000 to 7000 pounds of green fruit per 24 hours.

The Penniman evaporator is largely used and is highly



recommended in California. In the fall of 1895 the writer saw one in operation in Southern Oregon, and while the product, in this particular instance, was not first-class, the reason for which might be attributed to lack of care and attention on the part of

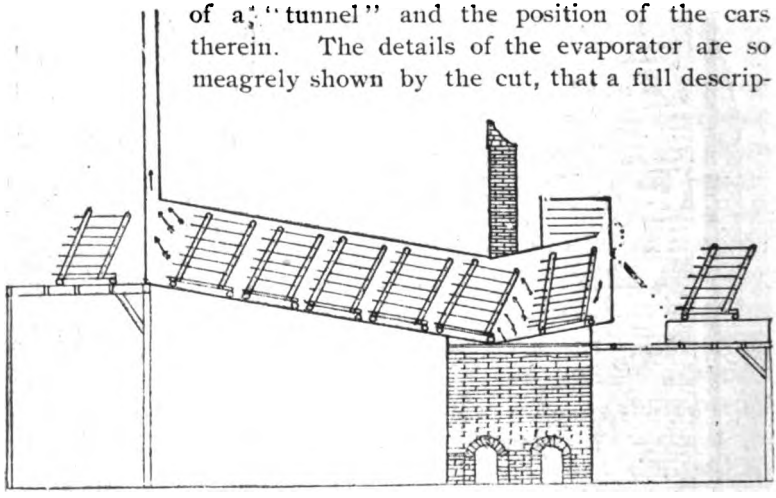
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the operator, yet there were some points of excellence about the machine. Its durability, safety from fire, the ease with which fruit may be handled, equal distribution of heat, therefore, approximately, uniformity in drying, are the points that commend it.

The Allen Evaporator.

The Allen evaporator is one of the popular evaporators in Oregon; more of them having been built, perhaps, in this state then of any other style excepting the Carson. It is a so-called horizontal evaporator in which the trays of fruit are moved horizontally across the heating surface. The American evaporator was, I believe, the prototype of this style of evaporators, but the Allen is a great improvement upon the old form.

The accompanying cut, a very poor one, represents the Allen evaporator with one side cut away; it shows the inside of a "tunnel" and the position of the cars therein. The details of the evaporator are so meagrely shown by the cut, that a full description will not be attempted; the essential principles of the drier can be readily seen, however.



Mr. Allen believes that prunes should be subjected to a low temperature when first placed in the drying chamber, and as the juice coagulates in the cells, gradually be given a higher temperature; the great majority of those experienced in evaporating prunes believe this, but the Allen evaporator is built with special reference to this point. To secure which, the prunes are put in at one end of the drying chamber and taken out at the

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opposite end. The device by which this is done is a series of cars running down grade in "tunnels," from the place where the fruit enters the drying chamber to the furnace. The foremost car is pulled across the entrance through which heat enters the chamber, this permits an opening between the cars and brings the upper end of the tray nearest the fire, thus answering the same purpose as turning the tray around would. The car is now in front of the door of exit and the fruit can be examined at will and taken out when the proper stage of evaporation is reached.

A current objection to the evaporator is, that the fruit can only be examined as it comes before the door in the last stages of evaporation. I have been told by those who have had considerable experience with the evaporator that the objection is not well taken, as the circulation of air is such that the fruit dries, in proportion to the distance from the fire almost perfectly.

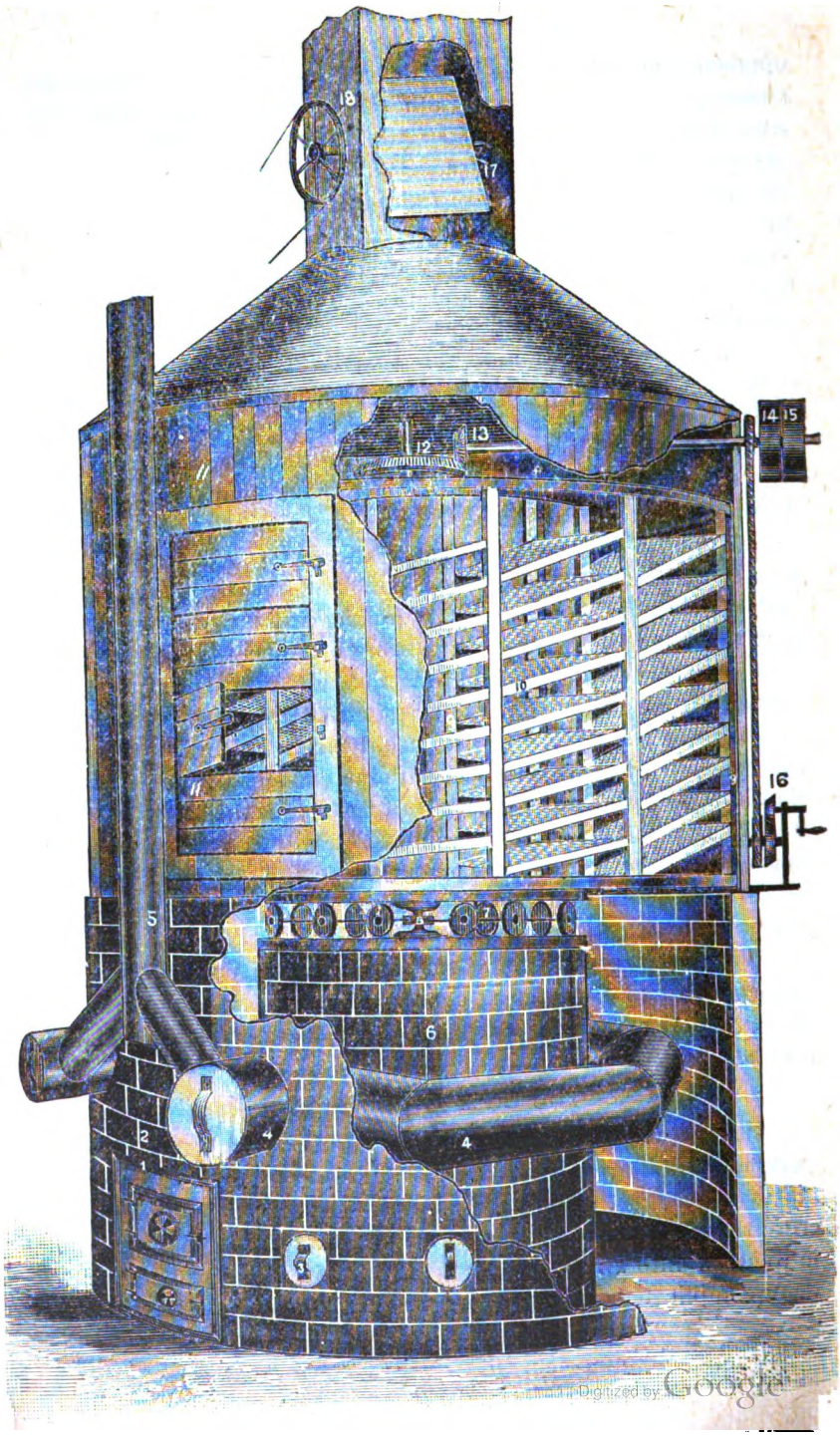
A great point of excellence in the Allen evaporator is, the way in which the hot air reaches the fruit, absorbs the moisture, and passes off. The tramways for the cars are constructed so that the edge of the car farthest from the heat is highest—the cars slant forward; as the heat ascends from the furnace it is carried between the trays, the driest air on the driest fruit. The cars are running toward the furnace, hence as the moisture leaves the driest fruit it passes out without condensing as it would should is pass over the greener fruit first. All the moisture from freshly dipped fruit passes out immediately. It is not saying too much to say that the heat is under as perfect control, by means of a novel system of dampers and ventilators, as in any evaporator we have.

Various sizes are made ranging in capacity from 25 to 175 bushels of green fruit per 24 hours. The cost is not excessive, it is economical in fuel, and it is easily operated,—all valuable points.

The Beck Evaporator.

It may be that our California neighbors, with their longer experience and greater resources, have brought forth better evaporators than those commonly in use in Oregon. But a general criticism upon such evaporators from that state as have been introduced into Oregon is, that they are far too expensive, with their complicated manipulating machinery for our conditions,

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and, especially as it is doubtful if better results are accomplished than with our simpler devices.

The evaporator under consideration, the Beck, while free from the many novel inventions of fans, blowers, domes, and other accessories has in its construction a feature, which, unless overcome by a much greater capacity gained by it, is objectionable; namely, the revolving tray rack involving as it does extra cost and a greater expense in running. The same criticism applies with equal force to the Penniman described before and the Kurtz to be described hereafter, and the rule may be laid down, in general, that evaporators that require a constant power to run them, or complicated machinery to be built and kept in repair in order that the fruit may be forced through the air instead of the air being forced by nature's laws through the fruit, must greatly exceed in efficiency the simpler and less expensive evaporators.

These criticisms must be taken as general and not as applying to the Beck in particular, an evaporator, which we consider of its style, the very best, and as having by increased efficiency, overcome some of the objections noted in the above paragraph. Its principle of construction is certainly most ingenious and well deserves the attention of every fruit-man.

The cut on the following page shows the plan of the Beck. Two circular, brick walls, one within the other, several feet apart, according to the size of the evaporator, are built about nine feet high. In the enclosed space formed by the two walls, a furnace of cast iron, two and one-half feet wide and nine feet long, is placed; attached to this is a heating drum eighteen inches in diameter which circles around the inner wall, passing into the smokestack near the furnace front. Upon the inner circular wall, is a turn-table upon which is a tray rack which extends out over the heating chamber to within half an inch of the outer wall.

The outer wall, from the brick work up, is built circular, as a continuation of the wall, the frame-work being covered on both sides with closely matched lumber thus making an air-tight compartment; at the top is a conical roof in the center of which is a ventilator with a damper to control the draught.

The trays slide into the revolving rack at an angle of six inches to three feet and edge to edge so that they wind around

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the inner wall from bottom to top in a spiral twist. The space between the twists of trays, are, in a sense, flues of the dimensions of the distance between trays and the width of a tray, and the hot air is supposed to ascend through them as it does in a chimney. To further facilitate the passage of air between the twists of trays, the tray rack is kept in motion thus forcing the air through the spiral flues under and over the trays of fruit, thus, seemingly, distributing the air current uniformly over the the fruit surface.

The power for turning the tray rack may be hand power in small evaporators, or, as of course would be better, a vapor engine or steam power may be used. In a plant of any magnitude the consideration of power is not so great as would at first appear, because there should be some such power for running graders, dippers, elevators, pumping water, etc. There being but little friction to overcome in revolving the tray rack, strong power is not needed.

The inventors claim that because of the rapid and continuous currents of air caused by the rotary motion the temperature may be raised from fifty to seventy-five degrees higher than it could were the trays kept at a standstill. This of course means a greatly increased capacity for drying. In regard to convenience and mechanism, the machine is as nearly perfect as any upon the market.

The Fleckenstein Evaporator.

The Fleckenstein is one of the latest evaporators to claim attention in Oregon. It was invented by Mr. Adam Fleckenstein of Woodlawn, Oregon; last year was its first season before the public and because of the failure of the prune crop in this state it could not be thoroughly tested. In the trials made, however, it was evident that its merits would rank it among the best of our evaporators.

The Fleckenstein is a most decided departure from any style of evaporator now in use in the Northwest. It falls in the category of so-called stack or tower driers, devices common in the berry and and apple evaporating industry, but not in the prune industry. The fundamental principles involved in this evaporator are not new, there being several prototypes in the East, notably the old Alden, the Williams, and the Automatic,

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perhaps one or two others. But many of the accessories and and details of mechanism are new and are great improvements upon similar parts used in other evaporators of this type. This is especially true of the lifting device.

The essential principle of a stack evaporator, which provides that the trays of fruit be placed in tiers in a shaft, admitting air only at the bottom and allowing it to escape only at the top, thus forcing hot air directly through the fruit, is a principle directly opposite to that involved in any other evaporator described in this bulletin. The inventors of all the other devices have sought to provide means by which air once touching the fruit could be passed out as quickly as possible without touching more fruit. It is not to be wondered at then that the splendid reports given of this evaporator by horticulturists of unimpeachable standing have created no little surprise.

The method of operating the Fleckenstein, as recommended, differs very radically from the method generally used in most other stack evaporators. The fruit in this case is put in the stack, not necessarily but recommended so, at the top, the coolest part, and is finished at the bottom at the warmest part. In this the inventor agrees with the great majority of our experienced prune producers that evaporation should start at a low temperature, but disagrees with most manufacturers of Eastern stack evaporators who advocate that the fruit be "finished" at the coolest part of the evaporator. In fact, Prof. L. H. Bailey* in a bulletin on evaporators, in speaking of a certain evaporator says its chief disadvantage is, "that the fruit is 'finished up' or removed in the hottest part of the stack, instead of being taken out at the top which is the coolest part of the stack." I think I make no mistake in saying that this is counted an advantage in in all the types of evaporators in use in Oregon, and the fact that this can be done in the Fleckenstein is considered one of its strong points.

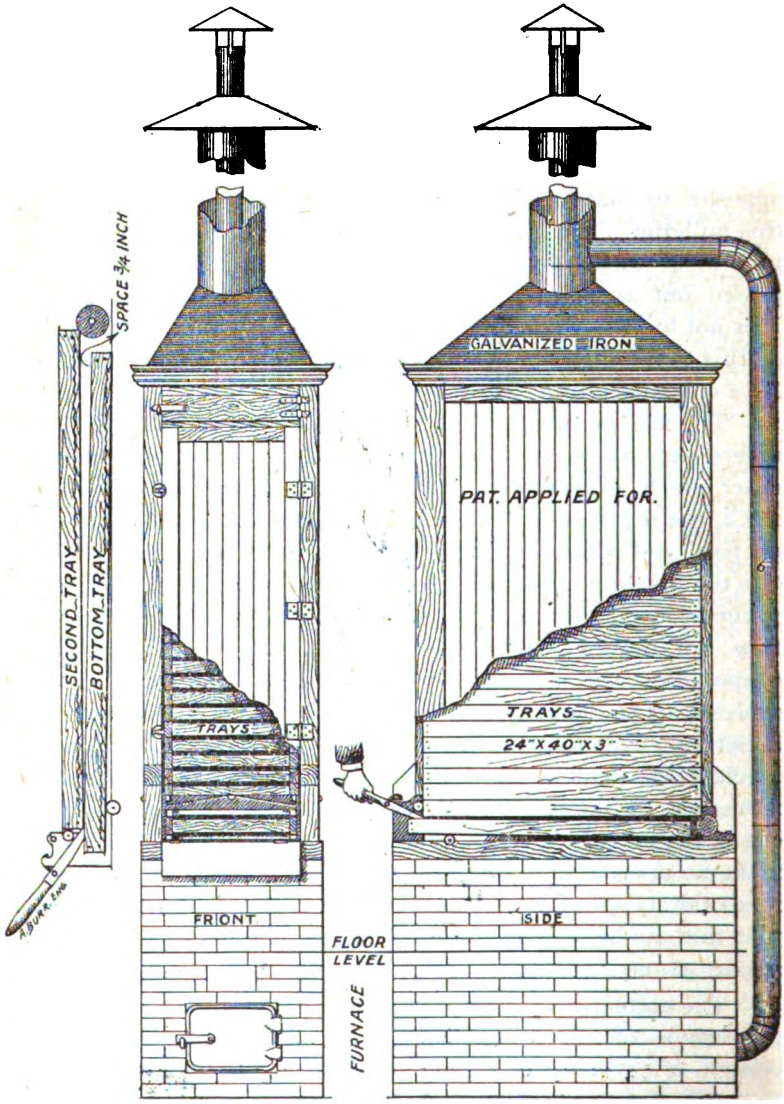
The accompanying cut represents one stack, holding twenty-five trays, of the Fleckenstein. An evaporating plant may consist of as many of these towers as may be necessary, all to be built over one furnace or several at the option of the builder.

The trays of fruit are handled in the stack as follows:

*Bulletin No. 100, Cornell University Expt. Station.

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The bottom tray rests on four small wheels imbedded in the frame-work of the stack ; the front end of the second tray



rests on the bottom tray and the back end rests on two four inch wheels raised about three quarters of an inch above the bottom

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tray, so that when the second tray with those above it are raised to a level, which is easily done by means of an ingeniously arranged lever placed under the front end of the second tray, the bottom tray is free and may be removed or examined and returned to place. If removed, the second tray, aided by the two four inch wheels behind slides gently down in the place vacated by tray number one. The bottom tray, it will be observed, is shoved forward an inch or two by the action of the wheels behind, upon which the back end of tray number two is forced to remain. Trays of fresh fruit are put in at the top.

One of the supposed requirements of the evaporator is, that it be air tight at all places except at the ventilator at the bottom of the stack, where air enters, is heated in the fire chamber, and drawn up through the fruit by a strong draught, created mainly by the smoke pipe of the furnace entering the ventilating shaft at the top of the evaporator.

Heat may be furnished by a furnace of any style, or by steam if desired. The inventor, however, has for a single stack or a small plant a furnace that is so simple, cheap, and efficient, that I take pleasure in describing it here.

The furnace consists of three lengths of common tile pipe twenty inches in diameter, encased in sheet-iron which is reduced at the back end to the size of a common smoke pipe and to which piping is fitted, carried around the air space under the fruit chamber once or twice, passed out and up into the ventilating shaft over the fruit chamber. It is an easy matter to fit doors, grates, and dampers. Mr. Fleckenstein has had such a urnace in operation in an old box drier on his place for six years. It has the merit of being exceedingly cheap, economical as to fuel, and the danger from fire is reduced to a minimum. A more elaborately constructed furnace is to be recommended for a large plant, however.

A strong point of excellence in this evaporator is its compactness. Twenty stacks of trays capable of drying 12000 to 20000 pounds of fresh fruit per twenty-four hours only occupies a space of 7½ × 17 feet. The mechanism is extremely simple and so the cost of evaporator and building will compare very favorably with the cheapest evaportors we have.

In the test made so far it is claimed that a first-rate quality

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of evaporated Petite prunes can be produced in from eight to ten hours, the prunes having a fine ruby color and the clear yellow flesh characteristic of a perfectly evaporated Petite prune. The Italian was as well dried in from ten to twelve hours, though it is considered best to take at least ten hours for the Petite and fourteen for the Italian.

The Kurtz Evaporator.

The cut on page 60 gives a view of the Kurtz evaporator, an evaporator with a revolving tray-frame somewhat similar to the Beck, differing from it in the manner of support of the tray-frame, and in not requiring continuous motion. The remarks made regarding the merits and demerits of this style of evaporator under the discussion of the Beck applies with equal force to the Kurtz.

The lower part of the evaporator consists of two circular brick walls, forming a furnace and hot air compartment. Above the inner circular wall, the tray-frame and apparatus for manipulating it are placed. The upper part of the outer wall consists of a tight wooden shell. The construction of these walls can easily be made out by an examination of the cut.

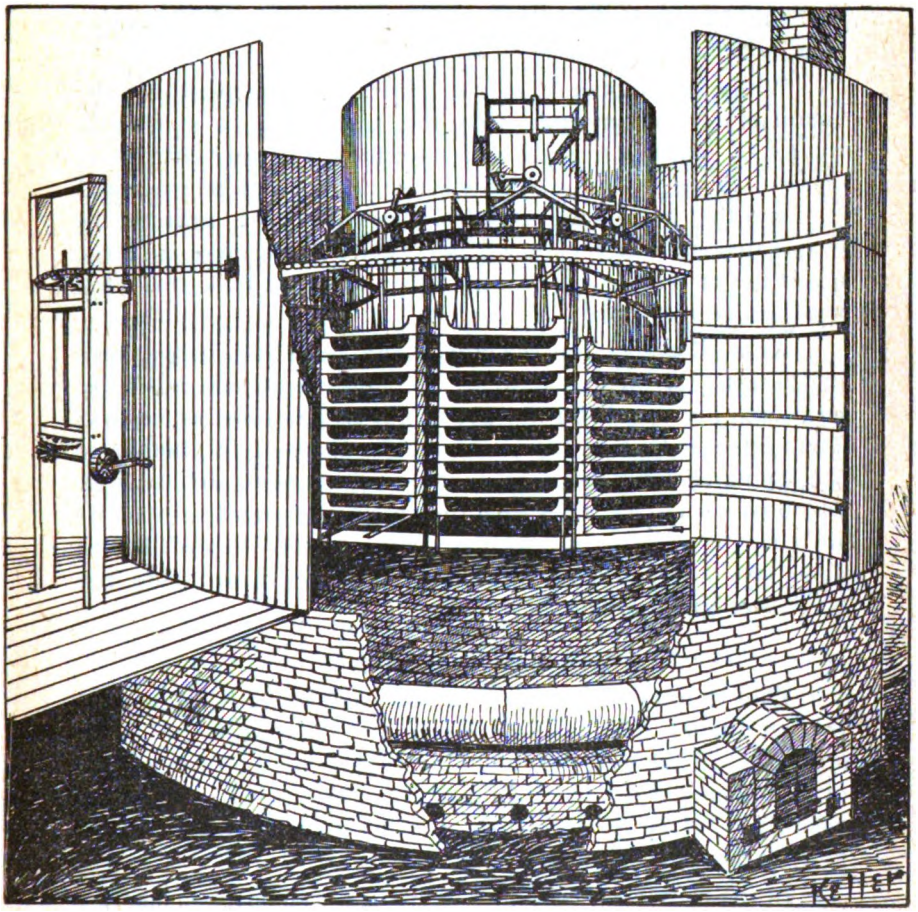
Formerly, the tray-frame rested on a track on the circular foundation, but it is now suspended from above upon supports resting upon the foundation; the frame is revolved upon roller bearings which operate between two tracks the lower of which is stationary, and the upper one, to which the frame is fastened, rotating upon the rollers. An endless chain passes entirely around the machinery and connects with a crank outside of the evaporator; by turning this crank the tray-frame is made to revolve so as to bring each upright section in turn in front of the door where fruit is put in and taken out.

The working theory of the evaporator is as follows: A horizontal row of trays of green fruit is put in at the bottom every two hours and a similar row of evaporated fruit is taken out at the top at the same time. In order to do this it is necessary to lift up each column of trays the space of one tray, hold it there by means of a spring dog, put in a tray at the bottom, take out one at the top, drop the column and repeat the operation until the trays have been changed in all the columns.

The lifting of the columns is done automatically as the tray-

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frame turns so that when the the frame stops in front of the door the column has been lifted and is ready to receive a tray. This is accomplished by means of a bridge to be seen in the cut exactly in front of the upper edge of the door if the door were closed. As the tray-frame is revolved, the roller attached to the



column of trays below rolls over this bridge and lifts the column which is then held by a dog which automatically springs out and catches it.

One of the current objections to the Kurtz evaporator has

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been that the fruit had to be subjected to the greatest heat immediately upon entering the drying chamber. Mr. Kurtz writes me that this year he has improved the tray-frame machinery so that green fruit can be put in at the top and the finished product taken out at the bottom if so desired. This plan will meet with the approval of most of our prune men though a few will contend that the old way is the better. One of the merits of the evaporator is that it can be used either way.

While in practice it is not generally so operated, yet the manufacturer recommends that the tray-frame be constantly rotated by machine power in order to create a greater circulation of air. Three or four revolutions per minute may be made and it is said that by this means at least one-third more fruit can be evaporated—a matter of much importance when there are large quantities of fruit to dry. The power required to do this work need not be very great.

As in all evaporators the furnace may be built largely according to taste. Mr. Kurtz, however, recommends the one ordinarily built with his evaporator; briefly it may be described as follows: The furnace is built in the inner circular part at the bottom of the drying chamber and consists of a simple curving arch through which pass small air pipes from the outside, arranged so that all air entering the drying chamber is thoroughly heated before doing so. Mr. Kurtz says that one cord of wood will cure 200 bushels of green prunes.

Accessories.

This chapter may well close with a few words concerning the accessories of a good evaporator. The profit in evaporating establishments is often fixed more by the convenience of arrangements for handling fruit, and by the skill, care, and cleanliness, given by the operator in the various processes, than it is by the style of the evaporator.

In the matter of cleanliness there is a wonderful chance for improvement about many of the evaporating plants I have visited in Oregon. Where floors are covered with spilled or refuse fruit, allowed to accumulate from day to day to sour and to be tramped under foot, an evaporating establishment becomes a most unpleasant place indeed. Not a little harm is also done by the

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swarms of flies, bees, and yellow jackets attracted to such places and by germs of rots and molds that find a congenial medium for propagation. Scrupulous cleanliness is one of the essentials of a good establishment.

But to get back to the matter of the topic. Particular attention should be given to the accessories of the evaporating plant. First of all there should be plenty of room. The building should be planned so that there may be a receiving room for the green fruit; a working room containing the dipping apparatus or pricker, the grader, and the sulphuring chamber; these and all the minor apparatus should be upon the first floor. If possible a second floor should be built for a sweating room and store-room, and also to hold the apparatus for packing the product. It is almost absolutely necessary to have an unlimited supply of good water. An elevator is convenient and will save its cost in a single season. Tools and a place for making and mending trays, preparing packing boxes, and doing odd jobs of carpentry, is quite necessary. It will be found that the evaporating apparatus proper will occupy but comparatively a small part of a good plant, and that the general outfit will have quite as much to do with the success of the establishment.

In Conclusion:

To have described in detail all the evaporators and appliances used in evaporating prunes would have led us far beyond the scope of a brief bulletin. Other evaporators than those mentioned, especially some that have gained prominence in the evaporating industry in the East, well deserve to have been spoken of but it was impossible to discuss all, and I have simply tried to give an idea of the most prominent types in use in Oregon. Good prunes have been produced with all of them and none should be entirely condemned from hearsay. One thinking of purchasing an evaporator should investigate as many styles as possible; he should see them in operation; talk with the operator; and always take in consideration as to how much success or failure may be due to the man using the evaporator.

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V. Diseases of the Prune.

THE STONE fruits in Oregon suffer from the attacks of comparatively few pests. Curculio, black-knot, and brown-rot to any appreciable extent, have not as yet made their appearance in our orchards. This immunity may be largely ascribed, I think, as far as the fungous diseases are concerned, to climatic conditions. It is certain at any rate that both of the diseases mentioned above have been from time to time introduced and yet black-knot connot be found to my knowledge in any orchard at present, and the brown-rot is confined to very limited areas; neither has ever manifested a tendency to spread with the fearful rapidity and destructiveness characterizing them in the East. We have then in this chapter to describe but few diseases, the worst of which is:

Shot-Hole Fungus.—*Cylindrosporium Padi*, Karsten.

This disease is prevalent in all parts of Oregon and is troublesome not only on the plum and prune but on the peach and cherry. It is the most grievous pest that growers of stone fruits in this state have to contend with and the necessity of spraying in order to protect prune, peach, and cherry from its ravages is now an established fact.

In the prune orchard it makes its appearance in June or a little before the leaves are full size. It first manifests itself on the leaves in little purplish or reddish spots, or brownish in the center and purple at the circumference. These spots enlarge, sometimes by coalescing, until they are from a sixteenth to a quarter of an inch in diameter. As the disease progresses the affected spots wither, turn brown, and finally break away and drop out of the leaf. The holes thus formed, sometimes a score of them being found in a single leaf, gives the foliage the appearance of having been riddled with shot hence the name, shot-hole

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fungus. The disease is well shown in Plate IV, Fig. 1, reproduced from a photograph.

Shot-hole fungus oftentimes may not attract attention unless as happens frequently the foliage drops prematurely; this generally takes place in August or September, the leaves turning yellow before dropping. It is obvious that any trouble seriously affecting the health of the foliage must be disastrous to the general health of the tree and must, in proportion to its seriousness, affect present and future crops. Fruit-growers do not always realize this and the presence of any pest that is not actually killing a tree seems to give them but little anxiety. The fact needs to be pressed home as forcible as possible that anything that in any way injures the foliage, in the same ratio injures the productiveness and longevity of the tree. Shot-hole fungus, because of its universal prevalence in Oregon prune orchards, does more damage than all the other prune troubles combined, and in the aggregate, yearly causes an enormous loss of fruit and a great retardment of our orchards.

Fortunately the disease is easily controlled. The Oregon Station has done but little experimenting in the way of preventing the disease, but the treatment recommended by other Stations has been given with success in our orchard. The disease has been thoroughly studied and for those who desire a more comprehensive knowledge than can be given here, I append at the bottom of the page a list of the most prominent reports of investigations concerning it.

Bordeaux mixture is the preventive for the disease. The shot-hole fungus appears in midsummer and applications for it must be made late in the season. The first spraying should be given very soon after the leaves make their appearance, this to be followed by a second and third application,—in a very wet season a fourth, at intervals of three weeks. It may sometimes be necessary to spray when the fruit is nearing maturity, if so, one of the clear copper sulphate solutions should be used instead of the Bordeaux mixture.

S. A. Beach, Bulletin 98, N. Y. Ex. Sta., Rep. N. Y. Ex. Sta. 1893: 688–693.
D. G. Fairchild, Bull. U. S. Div. Veg. Path. 1894–6: 39–40.
W. J. Green, Bull. Ohio Ex. Sta. 1891. II 4: 216.
Roland Thaxter, Rep. Conn. Sta. 1889: 176, 1890: 102.

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Brown Rot.—*Monilia fructigena*, Pers.

In the fall of 1895 a number of prunes affected with brown rot were sent to the Station. Upon making inquiry it was found that in the infested area nearly the whole product of several orchards had been destroyed by the disease. The writer could find no previous notice of its existence in Oregon and assumed that it had been but recently introduced. Subsequent inquiry developed pretty conclusively that it has been in Oregon for some time but seems to have been dangerous and troublesome only under particularly favoring conditions,—fortunately enough as the brown rot as found in most localities is the most serious fungous disease with which plum growers are obliged to contend.

In the East all the stone fruits are attacked by brown rot, the disease being especially prevalent in the Middle and South Atlantic states. In some seasons in Georgia, brown rot takes a third of the peach crop; in Michigan the aggregate damage done to the stone fruits is as great as that done by all other diseases combined, if we except peach yellows. A bad feature of the disease is that the fruit is often attacked after being picked, as was the case with one of the Oregon orchardists who lost fruit year before last; about 60 bushels of prunes ready for the evaporator in standing over Sunday were almost entirly destroyed by the rot. If it is true that the fungus has been in Oregon for some years without becoming more widely distributed there is but little to fear from it, but knowing its character elsewhere we need to be watchful.

The following is a brief description of the disease. Leaves, twigs, and fruit, are attacked, but most of the damage is done to the fruit. The rot makes its appearance about the time the prunes begin to mature, and the favoring conditions are, warm, moist weather, a certain amount of moisture being necessary at the point of contact of the fungous spore in order that germination take place. After germination the fungus enters the cells of the fruit and robs them of their contents and cell degeneration, or rot, ensues. The affected fruit becomes covered with clusters of ash-grey spores which enable one to easily distinguish it from ordinary decay. If the fruit is not harvested it becomes persistent and shrivels on the tree, it being no uncommon sight to see the shriveled fruit hanging on the trees in midwinter. Oftentimes the twigs of the trees, especially of the peach, are attacked. The blossoms

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are also sometimes affected and destroyed.

The life history of brown rot has been well worked out and experiment station literature abounds with references to it, some of the prominent notices of it being found in the bulletins cited at the bottom of the page.

The application of Bordeaux mixture which every prune grower should make for shot-hole fungus will keep brown rot in check though the rot may make, under favorable conditions, its appearance later in the season than the shot-hole; if it does, and at a time when the fruit is approaching maturity, the weak copper sulphate solution should be used or the ammoniacal carbonate of copper solution, the formulas for which are found at the end of the chapter. With this disease, more than almost any other, prevalence will depend on weather conditions, hence changes in temperature and moisture must be closely watched.

Black-Knot.—*Plowrightia morbosa*, Sacc.

Black-knot is a common and destructive fungus on stone fruit trees in the East, and is occasionally found in Oregon though here, as yet, it has never been plentiful enough to do harm. It, therefore, needs but a brief mention in this Bulletin.

Black-knot, as its name implies, is a blackish swelling on the twigs or limbs of the plum and cherry. These swellings are caused by a fungus and not by insects as one might be led to believe by the presence of the latter in many of the old knots. The disease makes its appearance at the beginning of growth in the spring when it may be seen as a light discoloration, growing gradually darker until in June it is purple; the bark at this time seemingly having a thin coating of purplish velvet, caused by the presence of myriads of spores with the organs bearing them. By midsummer the "velvet" has disappeared and the swellings are jet black. At the beginning of winter, minute, black elevations, on the surface of the knots, indicate the presence of the winter spores. They are distributed before spring and new growths are propagated from them. The knots are generally from three to

H. Carman, Ky. Rept. 1889 31—36.
C. McCarthy, Bul. N. C. Ex. Sta. No. 76: 14.
T. E. Humphrey, Mass. Rept. of Expt. Sta: 1890: 213—216.
L. R. Taft, Bul. Mich. Expt. Sta. No. 83; 17—18.
B. D. Halstead, Rept. N. J. Expt. Sta. 1891: 288—260.
F. D. Chester, Bul. 55, Del. Expt. Sta. 10—12.

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five inches long, although additions of new swellings from year to year often make them much longer.

The treatment generally recommended is to cut out the knots as soon as discovered and destroy them; of course the earlier in the season that this can be done the better in order not to allow a crop of spores to mature. The sprayings recommended for shot-hole fungus will tend to keep black-knot in check should it make its appearance. For the benefit of those who may wish to make further investigations of the subject the references at the bottom of the page are recommended.

Prune Rust.—*Puccinia pruni.* Pers.

In some parts of Oregon, the foliage and fruit of the prune have been seriously affected with a rust. Opportunity has not offered so that a study of the disease could be made at the Oregon Station, but I take it to be the same rust that troubles the California prune growers, a study of which has been made, and the results published, by Mr. Newton B. Pierce,* of the U. S. Department of Agriculture.

The rust is known to affect all drupaceous fruits, but does most damage to plums and prunes. It is widely distributed, being found to some extent wherever members of the plum family are found. In some localities the peach suffers greatly from the ravages of this fungus. Judging from what is said by Mr. Pierce in his article, referred to before, the disease is much more virulent in California than in Oregon. There, it seems, trees and orchards are sometimes almost defoliated and the damage done in the way of reducing the aggregate vigor and productiveness of prune, peach, and almond orchards, is immense. In Oregon the most apparent loss to the prune growers is in the quantity of the current year's fruit, or, sometimes, the fruit itself is attacked, the skin assuming a rough, russeted, condition, that greatly injures the appearance of the prune, and also makes it difficult to evaporate it well. But, as in California, the greatest damage is done through the weakening of the vigor and productiveness of the tree and the shortening of its life.

The fungus begins its work early in the season, and may be

E. G. Lodeman, Cornell Expt. Sta., Bul. 81, Ithaca, N. Y.
S. A. Beach, N. Y. Expt. Sta. Bul. 40.
*Journal of Mycology, Vol. VII, No. 4, pp. 354—363.

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seen soon after the leaves come out in the spring. Yellowish, irregular, blotches on the upper surface of the leaves, first indicate the presence of the rust. Soon after the spores make their appearance in brown patches on the under side of the leaf, and if the fungus makes a strong growth such portions of the leaf are usually entirely destroyed, presenting an area of brown, lifeless, seared tissue. In different years, localities, and conditions, the appearance of the rust varies somewhat. If the fungus attacks the fruit, the parts attacked swell slightly, become light brown in color, and of a rough texture.

The disease will be pretty well kept in check by the sprayings of Bordeaux mixture recommended for the shot-hole fungus, but in case the rust is particularly troublesome, an added spraying earlier in the season would be of value. The spores are borne on the underside of the leaf and probably germinate there; therefore the under surface should be thoroughly drenched with the spray to obtain the best results in spraying.

Gumming of the Prune Tree.

The prune, in common with all drupaceous fruits in Oregon, is much injured by the exudation of gum from the trunk and limbs of the tree. The trouble is called gummosis. The writer has never seen gumming elsewhere, except as a normal condition of the trees of this class, but inquiry shows that it damages plums, peaches, and cherries in other localities in the United States, as parts of California, Colorado, Texas, the South Atlantic States and Pennsylvania, and is also troublesome in certain parts of Europe.

Notices of the disease, however, in scientific literature, are short and very fragmentary. In fact none of our experiment stations, so far as the writer can ascertain, have attempted to assign causes for the excessive gumming or to prescribe treatment for it. On the other hand, it has frequently received attention in the horticultural press, where I find various causes assigned; as, a bacterium, a fungus, frost, sunscald injuries, over cultivation, etc. About as many remedies are prescribed.

As one of the greatest hinderances to successful prune and cherry growing in Oregon, gummosis has for several years received more or less attention at the Oregon Experiment Station. Most of the efforts put forth have been along the line of controlling the

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gumming and in this some results worthy of note have been obtained. During the past year a study of gummosis from a botanical standpoint has been made with a view of ascertaining the cause, and while conclusions have not been reached that warrant positive statements regarding all phases of the disease, yet enough has been done to warrant the stating of a hypothesis as to the cause, and to suggest remedies.

Gummosis may make its appearance at any time of the year if proper weather conditions prevail. It is most prevalent in the spring, especially if the growth has started prematurely, or if the trees have been injured by frost. Trees frequently gum badly, also, in midsummer after a hot wave, or a shower of rain. The first indication of the coming of the gumming, is the tight, smooth glistening appearance of the outer bark. This is closely followed by a swelling of greater or less magnitude, sometimes being not larger than a dollar, but oftentimes extending in irregular patches the whole length of the trunk of a medium sized tree. After a time these swellings burst and gum oozes out, continuing to do so for an indefinite period. If the diseased spot be cleansed it is found that the tissues of the tree have degenerated, and a pocket of some extent, according to the length of time the gum has been exuding, is discovered.

The gum is the same mucilaginous substance that exudes from the cultivated stone fruits the world over, occurring, however, generally as a normal condition, and, perhaps, serving some definite purpose of life. Its consistency varies considerably, ranging from a gelatine-like mass to a thick liquid slime, depending upon the period of growth, or, perhaps, primarily upon the amount of available water in the plant cells. The gum is insoluble in alcohol, slightly so in water and always swelling up in this menstruum; it is colorless, tasteless, and transparent. Chemically, the gum is one of the vegetable mucilages, and is a mixture composed chiefly of bassorin together with arabic acid and its isomer, metarabic or cerasic acid. These occur as compounds of calcium, potassium, and magnesium. The elements found in the acids are carbon, hydrogen, and oxygen in the proportion represented by the general formula, $(C_6H_{10}O_5)n$.

The gum is formed by a chemical metamorphosis of the cellulose composing the cell walls into the mucilage, in consequence

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of which it obtains the property of imbibing or absorbing water thus causing the swelling. The consistency of the substance depends upon the quantity of water absorbed. This degeneration of the cell wall may not, as is often the case, affect the health of the tree, but in the circumstances under consideration is always a diseased condition. The degeneration of plant tissue to form gum is to be distinguished from the gum—gumming from vesicles—found in many plants, as the Malvas, Elms, Basswoods and Pines. On the other hand it is formed much as is the gum-arabic, tragacanth, and bassorin of commerce. Like other secretions, they may under certain circumstances, be of use to the plants, but they have no value whatever as a means of adding to the food store of a plant. It was formerly thought that the powerful endosmatic attraction of water in plant cells, so necessary for plant growth, could only be brought about if the cells contained quantities of dissolved substances of the nature of gums, sugars, and proteids. This may be the function of the gum and would explain its presence in the trees in normal quantities.

As stated before, the most common cause popularly assigned for the excessive gumming is bacteria, or other micro-organisms. But in attempting to prove that micro-organisms cause the trouble, only negative results have been obtained; all things tending to show that such organisms appear subsequently and not as the cause of the gumming. From the orchardist's standpoint the theory that the disease is the effect of the work of some lower plant is even more untenable; for, gumming does not appear to be contagious; it is not in the least affected by sprays; all other fungous diseases are restricted in area in Oregon, but gummosis is found in all our orchards; affected trees often fully recovered without treatment of any kind; moreover, there appear to be other causes that clearly, and definitely, influence the flow of gum, and it is these that we assign as the chief cause of gummosis.

Injury to the plant cells seems to be the chief if not the only cause of the gumming. This injury seems to be done by two agencies, frost and heat. Hon. J. R. Cardwell,* President of the State Board of Horticulture, in the last biennial report of that Board, cites definite years and definite cases, dating from 1883

*Fourth Biennial Report Oregon State Board of Horticulture.

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in which gummosis, after late spring frosts, and after conditions which greatly favored sunscald, appeared so plentifully that one could only assign the coincidences as cause and effect. Mr. Geo. Coote, the Assistant Horticulturist at the Station, an old and experienced orchardist, has for twenty years observed the same relations between these agencies and gummosis. Hon. Chas. L. Dailey, Horticultural Commissioner for the Second District of Oregon, in a lengthy correspondence, details results of investigations and observations from an orchardist's standpoint, extending over two years, the results of which have well convinced him that gummosis is the effect of frost and sunscald, the former more particularly. Reports of this nature from prominent practical orchardists might be multiplied but these are sufficient.

Both scientific and practical work, then, lend color to the view that gummosis is the result of a degeneration of the tissues of the tree brought about by injuries, principally by frost and secondly, sunscald. Of course, whatever affects the general health of the tree, as lack of drainage, or over cultivation, would make the plant tissues much more easily affected than if perfect health prevailed, and it is possible that these may be at times a primary cause of the trouble.

It may seem needless to carry the discussion of a simple matter of injury by frost and sun so far as has been done in thus discussing gummosis, but I have treated the subject in detail hoping to set at rest the mooted question of what causes gummosis. It now remains to briefly speak of the proper treatment to give an orchard suffering from gummosis.

The great aim that an orchardist seeking to avert gummosis, should have in view is, to have the wood of his trees fully matured and hardened at the end of each season's growth and to keep them back from that luxuriance of growth, indicated by bark-bound trunks and long willowy branches, which seem to be present in trees presenting favorable conditions for gumming. An orchard may be treated in four ways to secure this condition of the wood.

1st.—It may receive a soil treatment that favors the maturity of the wood. Cultivation should be stopped as soon as the trees have made a growth of from two to three feet and every means should then be taken to have this growth harden and mature.

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Fig. 2.

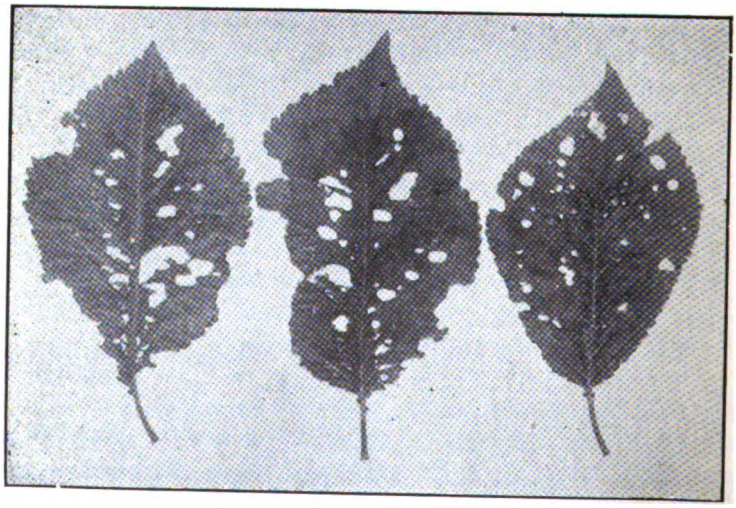


PLATE IV. *Fig. 1.*

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This may be accomplished by in any way restricting the water and food supply, as by planting a catch crop of any plant having large leaf surface, as crimson clover or buckwheat.

2d.—The trees may be pruned or rather pinched and so hasten the maturity of the wood. A removal of the terminal buds a month before the leaves fall will check growth and a removal of a few branches bearing the youngest leaves, which actively assimilate food, will do the same.

3d.—The slope or exposure of the land may favor maturity of wood, a northerly exposure being best.

4th.—The trees may be protected from sun and frost by wrapping with heavy paper, cloth, or straw. This treatment has been found effective in numerous cases with both prunes and cherries.

Curl-leaf of the Italian Prune.

A curious phenomenon is to be observed in relation to the Italian prune in the Pacific Northwest. Beginning in midsummer the leaves begin to curl conduplicately without withering, but shriveling somewhat. As the season advances the leaves become a yellowish brown and many of them drop. Plate IV, Fig. 2 shows the nature of the trouble.

This curling of the leaves is reported from all parts of the Pacific Northwest and practically affects all of the Italian prune trees there being but rarely a tree that escapes. As far as I can learn all other varieties are exempt. In some orchards the trees are almost wholly stripped of their foliage. It goes without saying, that the damage done is very great, not only to the fruit crop of the present year, but to the vigor and longevity of the trees. In fact, should this trouble continue, and every year be as serious as last season, and no means be found to check it, the Italian prune must be given up as a standard variety, as trees cannot produce good fruit or live long when subjected to such a drain of vitality as this curl-leaf entails upon the Italian prune.

There are several theories as to the cause of the trouble, but most of them are mere surmises to be rejected at first glance. The commonest belief is that some micro-organism causes the curling, but after a careful microscopic study, this theory seems to me untenable. Moreover the trouble does not act in the orchards as if it were caused by a micro-organism; for instance,

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it is found in all orchards no matter how isolated or how far removed from a source of contagion. Some say that only trees upon peach roots are attacked, but I am fully convinced that those upon plum roots are as badly attacked. The appearance of the foliage suggested to many, drouth. But trees are as badly affected in Eastern Oregon where orchards are irrigated as upon dry soil. While the trouble is greatly augmented by lack of drainage, poor cultivation, poverty of soil, and lack of pruning, yet it is prevalent to some extent when there is a surfeit of the opposite of any or all of these conditions, hence any one of them cannot be considered as a cause.

In a lecture given to the students attending the Short Course in Horticulture held at the College last winter Mr. M. O. Lownsdale* first made public a theory which seems to many the most fitting of any yet enunciated. Briefly, it is, that the trouble comes from a physiological or an anatomical defect or weakness in the leaf of the Italian prune under certain conditions, in which the contractile powers of the breathing pores of the leaf, or the guard cells surrounding the pores, are affected in a way that greatly hinders proper transpiration and respiration. Mr. Lownsdale suggests that Bordeaux mixture, by closing up the pores, may prevent much of the curling and orchards so treated coming under his observation seemed benefitted.

On my own part, the first surmise, after having given up the idea of any extended cause, or of the foliage being preyed upon by a micro-organism, was that the trouble might come from a weakness in the epidermal system of the leaves though I did not associate it to any extent with transpiration and respiration. This was suggested to me because the cells in the epidermal system seemed to be the only parts affected; they always assuming, in the latter stages of the curling and yellowing, a shriveled, corky, appearance. Upon a comparative examination it was found that these cells in the Italian leaves were much larger, seemingly having a more delicate cell wall structure, and differing in general from similar cells in other varieties much more than cells in other varieties differ among themselves.

The first appearance of the trouble last season was immediately after a very hot wave in July. The second bad attack

*See Short Course Lectures, Oregon Agricultural College, 1897.

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came after a hot wave in September. These hot waves extended pretty well over the whole Northwest. The fact that heat is the only unvariable factor that could possibly have to do with the trouble, lends much color to the view that heat, in connection with the weakness in the structure of the leaf of the Italian, as stated above, may be the cause. I offer this theory only as a hypothesis, hoping that another season may bring forth definite conclusions as to what the trouble really is, and, if any, the remedies for it.

Formulas for Fungicides.

I shall recommend but three formulas for fungicides, believing these three sufficient for all practical purposes. Bordeaux mixture is the favorite fungicide; the following are directions for making it:

BORDEAUX MIXTURE.

Copper sulphate	6 pounds.
Lime (unslaked)	5 "
Water	45 gallons.

Pulverize the copper sulphate; place it in a coarse sack and hang it in a quarter of the water to dissolve. Slowly slake the lime adding water only as fast as it is taken up; dilute until the lime-water is of the consistency of milk or cream, and then strain through a sieve or a piece of burlap into the barrel containing the copper sulphate solution. When ready for use dilute to 45 gallons. The principal object in adding the lime is to neutralize the acid copper sulphate. If sufficient lime is not added the foliage will be injured. Therefore, *always test as follows:* Dissolve ten cents worth of ferro-cyanide of potassium in a small bottle of water. Add a few drops of this solution to the Bordeaux mixture and if a brownish discoloration appears in the water where the drops fell, add lime until such discoloration does not appear. A little surplus of lime is always desirable.

The strength of Bordeaux mixture can be much reduced and yet be efficient in some cases. For the third and fourth applications 60 gallons of water may be used instead of 45. No fears of burning the foliage need be entertained if the lime is fresh, of proper amount, and carefully slaked. When needed, Paris green can be used as an insecticide with the Bordeaux, thus saving an extra spraying. Some Oregon growers recommend a

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greater quantity of lime, thus adding to the sticking qualities of the mixture. Four pounds of molasses added to the mixture will be perhaps more effective in making the mixture stick than the added quantity of lime.

When a large orchard is to be sprayed, a stock solution should be made as follows: Dissolve 40 pounds of copper sulphate in 40 gallons of water. Slake 50 pounds of fresh lime in a box. When to be used add the lime to so many gallons of copper sulphate solution. A sufficient quantity is added when no change in color is produced by the test given above. Dilute with 10 times as much water.

COPPER SULPHATE FOR WINTER SPRAY.

Copper sulphate..... 1 pound.
Water.....

The above is a cheap, simple, effectiv
spring spray. Its effect on the fungi is the s
though the mixture is not so lasting. It is o
never be applied to any plant then when the

COPPER SULPHATE SOLUTION FOR SUM

Copper sulphate.....
Water.....

This is to be used when fruits are n
period, when Bordeaux mixture would
spray takes the place of the copper carbona
believe, preferable to it. It is too strong fo
plants. For peaches there should be 500
pound of copper sulphate.

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THE FRUIT SOILS OF OREGON.

G. W. SHAW, A. M., Chemist.

WITHIN THE limits of this article it is out of the question to publish a detailed description of the soils of Oregon. Nor indeed has a very exhaustive study been made, hence in some cases it would preclude the possibility of very accurate generalizations. Still the question of soils is such a vital one to the horticulturist that he should be made acquainted with any facts, favorable or unfavorable, that are likely to affect the horticultural interests of the state.

Owing to the topography and climatic conditions of the state, sharp contrasts in agricultural possibilities are forced upon us. The Cascade range, 150 miles from the coast, divides the state into two parts, differing from each other so much in climate as to render the terms arid and humid strictly applicable respectively to the eastern and western parts of the state. The western area of this grand natural division is subdivided by the Coast range, between which and the Cascade lies the Willamette valley. While under the term humid area, we must include the entire western part of the state, yet the geological formations of the southern part of this area are so different from those of the Willamette valley as to give rise to an entirely different character of soils, and render it necessary to give them a place by themselves. Hence the retention of the term "Southern Oregon," as popularly used, to denote that portion of the western or humid

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area south of Lane county, is very apt for our present purpose. The area east of the Cascade range is so radically different from the humid area of the western part of the state as to bring about distinctly different soil conditions, but not different from those of other parts of the world having a scanty rainfall. It is in this sense of limited rainfall that the term arid is used. It does not in the least imply that the lands are not of equal value with those of the humid area. Indeed, it is true that this same "arid" soil, is from natural causes, likely to be the very richest in plant food.

With these few remarks as to the natural divisions of the state, I proceed to discuss some of the more prominent features of the soils as they appear from an examination of a considerable number of samples.

In the following pages only those elements which are of chief importance in having often to be replaced in the shape of commercial fertilizers, will be considered, viz., lime, potash, phosphoric acid and nitrogen. Just what constitutes a sufficiency of these materials for successfully growing a crop will differ somewhat with the nature of the crop, and *very largely with the physical condition of the soil.* Prof. Hilgard, than whom no one is more competent to judge, gives the following as to the minimum percentages for a thrifty growth of green crops:

"LIME.—0.10 per cent in the highest sandy soil; 0 25 per cent in clay loams; 0.30 per cent in heavy clay soils, and it may rise with advantage to one or two per cent.

"PHOSPHORIC ACID.—In sandy loams, 0.20 per cent when accompanied by a good supply of lime. The maximum found in the best Mississippi table lands was 0.25 per cent; in the best bottom land of the same region, 0.30. His investigations in connection with the Northern Pacific survey also showed that this ingredient was more abundant in the soils of Oregon and Washington than in the soils of California.* In the basaltic soils it may even run as high as .30 or more.

"POTASH.—The potash percentage of heavy clay upland soil and clay loams ranges from about 0.8 to 0.5 per cent; lighter loams from 0.45 to 0.30; sandy loams below 0.30 and sandy loams of great depth may fall below 0.10 consistent with good productiveness and durability. Virgin soils with a less percentage than .09 he finds deficient."

The same author says in another article that "no virgin soil having .50 per cent, or over of potash will wear out first on that side of the store of plant food; and much less will suffice in the presence of much lime and humus."

"HUMUS.—This is of great interest to us since it is the storehouse of

*Cal. Expt. Station Report 1888.

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the nitrogen supply and its determination serves as a measure of the nitrogen. In oak uplands of the cotton states the range is usually between .70 and .80 per cent; in the poorer sandy soils from .40 to .50 per cent; in black calcareous 1.2 to 2.80 per cent. In Western Oregon it is not uncommon to find 3 and even 6 per cent."

It is not our purpose to discuss at this time individual soils except so far as they serve the purpose of illustration, but rather to discuss general soil propositions and to point out some of the differences existing in the typical soil areas. As a basis for discussion, below will be found a table showing the average composition of the Willamette valley soils, made up from 42 analyses, and in parallel columns will be found the average composition of California soils, and of the humid region farther east. When studied in the light of the preceding principles of interpretation much information may be gleaned.

TABLE I.

ANALYSIS OF FINE EARTH.	Willamette Valley.	Average for States.* (Humid.)	Average for California.* (Arid.)
Insoluble Matter	65.18	84.03	67.88
Soluble Silica	5.02	4.21	8.96
Potash (K_2O)	.23	.22	94
Soda (Na_2O)	18	.09	.28
Lime (CaO)	.83	.11	1.08
Magnesia (MgO)	.76	.23	1.49
Manganese (Mn_3O_4)	.08	.13	.06
Iron (Fe_2O_3) Alumina (Al_2O_3)	16.45	7.43	15.02
Sulphuric Acid (SO_3)	.03	.05	.05
Phosphoric Acid (P_2O_5)	.21	.11	.08
Water and Organic Matter	10.77	3.64	4.40
Total	99.77	100.19	100.05
Humus	1.63	1.50†	.75

Turning attention at first to the lime content, we find it to be .83 per cent, a somewhat higher figure than that given as probable from data at hand four years ago. Basing our judgment on the principles previously laid down, the valley soils as a rule could not be considered deficient in this ingredient, the figures in many text-books notwithstanding. It is popularly

*"Relation of Soil to Climate," Hilgard. †From limited data.

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supposed that the valley soils are deficient in this ingredient, hence I feel that on account of this widespread idea, and its great importance to the horticultural interests, the matter demands a careful consideration. I am at a loss to understand the general acceptance of this idea, unless it be, *first*, that no considerable deposits of lime occur within this area, *second*, that the older text-books have placed the limits for a calcareous soil altogether too high (from 4 to 20 per cent), as shown in more recent experiments, *third*, that poor results are often obtained with clover which is known to be a lime-using plant. However it may have sprung up *it is a fallacy*, at least so far as the bottom lands are concerned. Waiving the first possible cause of this notion as indicating nothing on the negative side of the lime question, as there are other compounds which may give rise to lime in soils, we come to the text-book statement concerning a calcareous soil. It is admitted that the soils are not *markedly* calcareous, yet "very much smaller percentages suffice to do all that lime can do: in very sandy soils less than two-tenths of one per cent impart the calcareous character to vegetation; in very heavy clay soil, from one-half to three-fourths of one per cent is necessary for the same purpose. But any further addition of lime to such soils changes the character of the vegetation no further, unless pushed to the extent of modifying materially its physical condition."* It is admitted as true that poor results with clover are often obtained, but that this is due rather to the present physical condition of the soil than to any inherent deficiency has been amply proven by results obtained at the Station, and also *by those farmers who have solved the problem of a proper physical condition for the crop. At the present time lack of drainage lies at the root of the difficulty with this and many other crops in the Willamette valley.* The presence of lime is well shown in the trouble so often experienced with the drain tile made in the valley. The tile are often found to blister and crack, which under the condition may be easily explained from slaking of the quicklime formed in the burning of the calcareous clay. The soils of the Willamette valley seem to be moderately supplied with lime, but carry a much less amount than either the soils of Southern or Eastern Oregon, the former on account of geological

*"Soil Studies and Soil Maps," (Hilgard) in Overland Monthly.

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reasons, and the latter on account of climatic conditions. That these soils should be fairly well supplied with lime would be expected from *a priori* reasons on account of the basaltic origin a large part of them. The lime in the valley soils is not altogether in the form of a carbonate, indeed it is rare that sufficient carbonate is present to cause evident effervescence with acid, but even a casual examination shows a very common occurence of *easily decomposable zeolites*, from which, by weathering, the lime may be constantly supplied. The decomposition of such rocks as those mentioned above *would naturally produce soils rich in lime and poor in potash*. Referring now to the minimum per cent of potash for a strong clay loam we find it ought to carry at least .30 per cent. to be consistent with good productiveness and durability, but in referring to the average content of the valley soils we find but .23 per cent, an amount much smaller than could be desired. But this is as consonant with our premise that such soils are likely to be low in potash as is the high lime content. It is altogether probable, however, that the potash of these soils is of a high general availability on account of the widespread disintegration of basaltic rock and zeolites. It is a well known action of lime to render available potash compounds otherwise inert. Just here, methinks, is, in a measure at least, the explanation of the wonderful fertility of the Northwest soils, but long continued draughts on the side of potash, as will be made by prune culture, is likely to rapidly deplete the soils of this ingredient. Knowing this about the potash content of our soils is it not reasonable to assume that this fact has something to do with the lack of thrift of old apple orchards as well as a lack of flavor in the fruit? For it is a fact well known to science that when potash is deficient in soils plants suffer greatly in their woody portions, which is likely to render them susceptible to attacks of fungous diseases, and in the fleshy part of the fruit, hindering the formation of starch and its conversion into sugar. Taken altogether, then, this question of the relation of potash supply to the health and thrift of our prune orchards, which remove large amounts of this ingredient, is a most important and interesting one, and will demand careful study on the part of the Station. *In the light of the present indications it is altogether likely that when the valley soils "give out" it will be first on the*

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side of potash, and that in not a few instances could it be used to advantage now.

Analysis shows the phosphoric acid content to be about .21 per cent, which is all that could be desired, yes, even abundant. It is not at all likely that this will be demanded for many years to come, and this will be particularly true of the hill lands. *This heavy per cent of phosphoric acid in our soils, together with the probably high general availability of what potash does exist, will go a long ways toward explaining the long continued productiveness of the Northwest soils, when sowed to grain But when the conditions are so changed as to bring the draught very heavily on the side of potash, as will be done in prune culture, if we may judge from the chemical nature of the soils, it is not at all probable that anything like these lasting qualtities will be shown.*

The humus content of the soils—a fair measure of nitrogen—is excellent, 1.63 per cent, and largely exceeds that of California, .75 per cent, in whose soils the potash content is high. With proper care in the treatment of our soils it will be a long time before high-priced nitrogenous manures will have to be resorted to. It is not at all uncommon to find soils showing 2.5 per cent, and in rare cases even more.

I am now to speak briefly of the classes of soils, but limit it to those most prominent, for to undertake a consideration of the varieties due to local causes would demand much more data than is at our command.

In general in the bottom lands of the Willamette valley the soils have a tendency toward clay loams, with clay subsoils forming a hard-pan at varying depths. There are apparently two classes of these soils, one a dark loam, and the other more properly described as a gray loam, running into the so-called "white lands." These are really of about the same chemical nature, and probably represent only different stages of drainage capacity, which has brought about subsequent difference in their composition. Even the so much despised "white land," when properly drained, rapidly takes on the appearance of the other soils both as to color and texture, the better drainage of the darker soils, excepting the adobe, allowing more perfect humification, and preventing the loss of much valuable plant food. *These loams are rich in phosphoric acid, and humus, well supplied with lime, but*

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weak in potash. Below will be found their average composition.

Analysis of Fine Earth. (Bottom Lands.)

Insoluble matter	64.72
Soluble Silica	4.39
Potash (K_2O)	.24
Soda (Na_2O)	.18
Lime (CaO)	.83
Magnesia (MgO)	.81
Manganese (Mn_3O_4)	.08
Iron (Fe_2O_3) / Alumina (Al_2O_3)	17.15
Sulfuric acid (SO_3)	.03
Phosphoric acid (P_2O_5)	.19
Water and Organic matter	10.57
Total	99.19
Humus	1.69

On account of the greater depth and lime supply of these soils they are perhaps the better prune soils, but the red hill soils *of sufficient depth* may equal them in potash and humus content, and surpass them in phosphoric acid, but it is not probable that the potash of the hills lands is as available. These red hill lands are nearly always better drained, and unless careful attention is paid to drainage of the bottom lands, they may well be chosen in preference to the latter. No better soil could be desired physically than that upon which the Belfontaine Prune Co.'s orchard is located, an analysis of which is here given. Physically it does not differ materially from the average of these lands.

Analysis of Fine Earth. (No. 411.)

Insoluble matter	65.74
Soluble Silica	4.94
Potash (K_2O)	.21
Soda (Na_2O)	.40
Lime (CaO)	.46
Magnesia (MgO)	.05
Manganese (Mn_3O_4)	.01
Iron (Fe_2O_3) / Alumina (Al_2O_3)	12.50
Sulfuric acid (SO_3)	.02
Phosphoric acid (P_2O_5)	.34
Water and Organic matter	14.82
Total	99.55
Humus	5.96

There are many prune orchards now on bottom land that will be short-lived unless attention is soon given to draining them. Wretchedly bad drainage is the most common fault of prune

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orchards in the valley, either from ignorance concerning the necessity of this all important matter, or from a "penny wise and pound foolish" policy of large acreage instead of a well prepared soil. This matter of drainage demands the attention of all horticulturists.

The following shows the average composition of the red lands:

Analysis of Fine Earth. (Red Lands.)

Insoluble matter	63.43
Soluble Silica	7.76
Potash (K_2O)	.27
Soda (Na_2O)	.59
Magnesia (MgO)	.62
Manganese (Mn_3O_4)	.01
Iron (Fe_2O_3) / Alumina (Al_2O_3)	15.46
Sulfuric acid (SO_3)	.01
Phosphoric acid (P_2O_5)	.29
Water and Organic matter	11.89
Total	99.33
Humus	1.34

To summarize the matter of valley fruit soils, the bottom lands offer, as a rule, the following advantages over the hill lands:

1st, Greater accessibility.

2d, Greater depth.

3d, Greater lime content.

4th, Probably a greater availability of potash.

As an offset the following advantages are offered by the hill soils:

1st, Better drainage, and therefore a more friable soil.

2d, Better supply of phosphoric acid.

In other respects there appears to be little to choose between them chemically.

Southern Oregon Soils.

There are two prominent valleys included in this area within which prunes are grown to a greater or less extent, the Rogue and the Umpqua river valleys. On account of the limited amount of work done upon the soils of this area it is not possible to present data with so much certainty as in the case of Willamette valley soils.

The characteristic soil of the southern area seems to be a reddish clay, which terminates in the high plateaus. The

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characteristic dark loams, resulting from the decomposition of carbonaceous slates, occur in abundance throughout the valleys. Granite soils are also a common feature of the Rogue river valley.

From analyses that have been made it appears that *the soils of Southern Oregon in general carry considerably more lime than do the soils of the Willamette valley*—at least twice as much—the average so far stands 2.22 per cent for the former against .83 per cent for the latter. Such a condition we would expect to find from geological reasons, this section having been the area of fringing and barrier reef lime deposits in the early geological history of Oregon. The lime is most frequently present as a carbonate. The approximate average composition of the soils is as follows:

Analysis of Fine Earth. (Southern Oregon.)

Insoluble matter	62.45
Soluble Silica	8.74
Potash (K_2O)	.34
Soda (Na_2O)	.21
Lime (CaO)	3.22
Magnesia (MgO)	.80
Manganese (Mn_3O_4)	.25
Iron (Fe_2O_3) / Alumina (Al_2O_4)	15.35
Sulfuric acid (SO_3)	.01
Phosphoric acid (P_2O_5)	.13
Water and Organic matter	9.52
Total	100.02
Humus	2.25

It is safe to say that the soils are stronger than the Willamette valley soils, not only in lime, but also in potash, *but weaker in phosphoric acid. It is not likely that these soils will first wear out on the side of potash, but rather on the side of phosphoric acid.* In this respect they approach the California soils as will be seen upon examination of the table given on page 78, although richer in phosphoric acid. The humus content of the soils of Southern Oregon thus far examined has been considerably higher than in the Willamette valley. We are not prepared to offer an explanation of this fact at present, although it may be due to the long continued wheat crops grown on the latter soils, and the open culture thus necessitated.

Taken all in all *the most lasting soils for the prune in Western Oregon will doubtless be found in the dark loams of the Umpqua valley.* These are fairly represented by the following analyses:

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Umpqua Valley Soils.

ANALYSIS.	No. 612.	No. 613. (Sub-soil.)
Coarse Material	93.00	90.00
Fine Earth	7.00	10.00
ANALYSIS OF FINE EARTH.		
Insoluble matter	64.84	66.03
Soluble Silica	5.57	8.33
Potash (K_2O)	.33	.21
Soda (Na_2O)	.26	.13
Lime (CaO)	2.32	5.15
Magnesia (MgO)	.83	.72
Manganese (Mn_3O_4)	Trace	Trace
Iron (Fe_2O_3) / Alumina (Al_2O_3)	15.77	12.78
Sulfuric acid (SO_3)		
Phosphoric acid (P_2O_5)	.04	.14
Water and Organic matter	9.52	7.05
Total	100.58	100 54
Humus	3.55	.11

The red soils of the foot-hills of the southern area are likely, from their origin, to be quite variable in their composition, which will, perhaps, account for the ill esteem they have acquired. Before orchards are placed on these soils there should be a very thorough investigation of their lasting qualities. *The granite soils are proverbially short-lived.* They usually carry a high per cent of potash, but are sure to be very variable. While orchards are likely to do well on these soils for a time, they will not be found durable for prune culture.

I have been asked several times as to the "adobe" soils of Southern Oregon and have replied, and do reply now, as follows, and it is as true of the Willamette valley as of Southern Oregon:

There are two classes of soil that commonly pass under the term "adobe" in each of these sections--one a soil sour on account of an excessive amount of organic matter, and consequently after neutralizing the acidity by applications of lime this soil is as easily handled as most others. The soil is well supplied with plant food and is likely to be durable. The other passing under this name is an intensely tenacious black soil, rich in organic matter and usually in other plant food, being weakest in potash. On the following page an analysis is presented.

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Adobe Soil No. 454.

Coarse Material > .6 m. m.	32.79
Fine Earth	67.21
Capacity for water	46.00

ANALYSIS OF FINE EARTH.

Insoluble matter	52.68
Soluble Silica	6.85
Potash (K_2O)	.19
Soda (Na_2O)	.09
Lime (CaO)	.65
Magnesia (MgO)	.46
Manganese (Mn_3O_4)	.23
Iron (Fe_2O_3) / Alumina (Al_2O_3)	18.56
Sulfuric acid (SO_3)	.04
Phosphoric acid (P_2O_5)	.13
Water and Organic matter	13.60
Hygroscopic Moisture	6.62
Total	100.00
Humus	5.59

It is impossible to treat this satisfactorily except by tile drainage. When so drained it forms a most excellent soil for fruit and other crops. In its present condition it is not at all suited to fruit, although pears, and possibly some varieties of apples, might be placed upon it, after it has once been well cultivated, if kept in excellent tilth for an inch or so. The first cultivation, however, is difficult to secure for it must be made at exactly the right time. Mulching would be beneficial to prevent rapid surface evaporation which causes compacting and cracking. Straw could be utilized to good purpose in mulching this land. *No permanent remedy can be expected except by under-draining.*

Soils of Eastern Oregon.

The appearance of the soils in Eastern Oregon is altogether different from those of the western part of the state. By far the larger part is of a gray, ashy appearance, darkening much on being wet. One coming from the darker soils of the Eastern States would be unfavorably impressed, but experience teaches that these soils are abundantly supplied with plant food, and analysis shows that they are probably the most fertile soils of the state. The wonderful fertility of these soils is shown in their enormous yield of crops from year to year. The soil is exceedingly deep in most localities, and of such a texture as to be easily worked.

The difference in composition between the soil of Eastern

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and of Western Oregon is well shown by the following table, giving averages of a considerable number of analyses.

Analyses of Fine Earth.

	Willamette Valley.	Eastern Oregon.
Insoluble matter	65.18	66 59
Soluble Silica	5.02	13.12
Potash (K_2O)	.23	.43
Soda (Na_2O)	.18	.22
Lime (CaO)	.83	1.22
Magnesia (MgO)	.79	.75
Manganese (Mn_3O_4)	.08	.10
Iron (Fe_2O_3) / Alumina (Al_2O_3)	16.45	10.68
Sulfuric acid (SO_3)	.03	.04
Phosphoric acid (P_2O_5)	.21	.14
Water and Organic matter	10.77	6.21
Total	99.77	99.51
Humus	1.63	1.44

Comparing the soils of the arid with the humid areas along the lines of so-called critical elements. it will be noted that the two sections differ markedly in lime content—*the Eastern Oregon soils carrying much more lime than those of the humid or western area.* There is one feature that differs materially so far as observed, viz., that *there appears to be no great difference between the lime content of the uplands and the lowlands of the arid area.* This conforms with conditions pointed out by Prof. Hilgard, of California, *that all arid soils are naturally calcareous.** The converse of this, however, is by no means true, for there may be local causes which will very materially alter the conditions. We have an illustration of this in the southern area of the humid region, where the lime supply suspasses that of the arid area. (See page 78.)

The potash supply of the Eastern Oregon soils is also superior to that of the humid area, standing .43 per cent against .23 per cent. In view of this abundant supply *it is not at all likely that these soils will wear out on the side of potash.* The greater abundance of potash in these soils is augmented much by being in a very soluble form thus rendering it even more available than that in the soils of the Willamette valley. The phosphoric acid supply of the humid area, however, is superior being .21 per cent against .14 per cent for the Eastern Oregon soils. This is doubtless the weakest point in the soils of the arid area of the Northwest.

*Report of California Station, 1892–1893.

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The humus percentage is excellent, although, as might be expected from climatic reasons, not as high as in the Willamette valley, *but recent experiments indicate that the humus of the arid regions carries much more nitrogen than do those of humid areas in the ratio of 3 to 1.** If in future experiments this proves to be true in our state, as without doubt it will, it means that while the humus per cent is lower the actual nitrogen content is higher in the Eastern Oregon soils than in those of the western area. Summarizing the lime, potash, and phosphoric acid of the three great areas we find it as follows:

TABLE II.

	Willamette Valley.	Southern Oregon.	Eastern Oregon.
Lime (CaO).....	.83	2.22	1.22
Potash (K_2O).....	.23	.34	.43
Phosphoric acid (P_2O_5).....	.21	.13	.14

The climate has much to do with these differences, although the abundance of lime in the southern area is mainly due to geological reasons as mentioned before. The difference in rainfall, forming the basis of our classification into humid and arid areas, is admirably set forth in an article by Mr. B. S. Pague, so long at at the head of the Weather Bureau in this state.†

"The air, ladened with moisture, passes from off the ocean, and meets its first obstruction, the Coast Range of mountains, on which and to the westward to the ocean the moisture is condensed and falls in the form of rain. * * * * The moisture which is not precipitated on and to the west of the Coast Range is carried across the Coast Range and distributed through what is locally called the Willamette, Umpqua, and Rogue River Valleys extending from the Columbia River to the California line. These are the interior valleys; and in them the moisture decreases from the north to the south, the average rainfall at Portland, in the north, being 49 inches annually, while at Ashland, on the south, it is but 21 inches annually. The moisture-laden winds, continuing on their eastern course, pass over the Cascade Mountains; and having deposited a large proportion of their moisture already, but little remains for the vast area east of the Cascade Mountains, termed Eastern Oregon. This section of the State has an elevation south of the Columbia Valley of from two to six thousand feet, and has an average annual rainfall of from 10 to 15 inches. In the Columbia River Valley the annual rainfall varies from 14 to 20 inches. This brief resume shows a decline in the amount of precipitation from the west to the east."

Thus it is seen that there is a difference of from 20 to 30 inches in the annual rainfall of the two sections. *This difference in rainfall and the lower level of the bottom water, or county drainage, ex-*

*California Station Report, 1892–93. †Resources of Oregon.

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plains the accumulation of lime, potash, and other soluble compounds in the soil of the eastern area In not a few instances have these accumulated to such an extent that the salts appear on the surface in the dry season as alkali. In a later bulletin it is intended to discuss this more at length, but inasmuch as in a few instances orchards have been placed on these soils they demand a passing notice. It is well to state here that the material composing alkali is no different than that being formed constantly everywhere, and that its appearance on the surface is simply due to the fact that the rainfall is insufficient to carry these soluble salts into the country drainage, but from year to year they are periodically washed into the soil to the depth of a few feet only to rise again with the evaporation of the water at the surface. Hence it is seen that the deeper the water penetrates—provided only it does not reach the country drainage—and the greater the evaporation, the more salts will there be brought to the surface to appear as alkali. The depth to which the water of precipitation penetrates in most cases is marked in most by the existence of a hardpan at varying depths. This hardpan has invariably been formed by the cementing action of the lime upon the diffused clay carried down by the storm water. These basins are always found underlying bad alkali spots and *before any permanent cure can be effected the impervious layer must be destroyed, otherwise, whatever may be done will be but a mere makeshift.*

It is well known to those who live in regions where alkali prevails that there are two kinds, viz., the white and the black varieties. Of these the former is by far the least injurious on account of its comparative neutrality. The main ingredient of the white variety is sulfate of soda, which, not having the power to dissolve the organic matter of the soil, remains white. It is comparatively harmless, and unless it has accumulated in excessive amounts is easily managed. *The most permanent remedy will be under-draining the land with tile and then thoroughly washing out the salt.* This is the *best* as well as the most expensive means of removing the difficulty. There are other cheaper and less expensive remedies such as digging open ditches lower than the level of the surface of the land to be treated, running these drains into the nearest natural outlet. Then by flooding these lands, not allowing the water to stand long enough to soak into the soil

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and thus carry with it the dissolved salts, most of the alkali that has collected on top can be removed. This treatment repeated a few times and followed by thorough and deep cultivation will be all that is required. In many cases, where the white salt has not accumulated in too great quantities, deep and thorough cultivation will be all that is needed. Such frequent and deep tillage keeps the ground in good tilth, and prevents the rapid surface evaporation. It also mixes the top, which is likely to be the strongest, with the soil lower down, and therefore dilutes the salt. It would be far better to avoid these soils for fruit unless they are permanently cured by under-drainage, devoting them to other crops which can be used to advantage.

The black variety of alkali is far more difficult to deal with on account of its ability to dissolve the organic matter, *humus*, of the soil. In times of drought these spots are marked by a series of black rings left about the margins of the dried up pools. The active alkaline ingredient of these soils is sodium carbonate, commonly called sal soda. the corrosive action of which is well known to housekeepers. When water is available, chemical remedies, coupled with those given above, may be successfully employed. By means of gypsum applied at the rate of 500 lbs. per acre, the black form will be changed to the white, which may then be given the above treatment. *Gypsum is the only practical antidote for black alkali.* It should be sowed broad-cast, and well harrowed in.

Certain crops also have the power to remove a considerable amount of alkali from the soil if grown for several years in succession. Among these are beets carrots, turnips, and any crop which will shade the ground thereby lessening the amount of surface evaporation.

These alkali soils are the very richest in the state, a number of the compounds composing the alkali being recognized as of direct value as fertilizers, as sulfate of potash, phosphate of soda, nitrate of soda, chlorid of soda, and carbonate of ammonia, which occur together with the sulfate of soda, and carbonate of soda mentioned above. Thus it will be seen that from the very nature of the case these soils are bound to be very lasting, and in many instances will well repay for the trouble required to recover them.

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THE COMPOSITION OF OREGON PRUNES.

By G. W. SHAW, A. M.

OUTSIDE OF the state of California but little systemati investigation of the chemistry of fruit has been undertaken in the United States, and if grapes and wine be excepted, but a limited amount of work has been done there. Quite extensive plans had been formulated for studying undried prunes the past season, but the conditions which prevailed rendered it impossible to prosecute the plan in full. It is intended that these investigations shall be a part of the continuous work of the Station, and to study not only the composition of prunes and other fruit, but also the draught of the various fruits on the soil. It must be borne in mind that such work is extremely intricate, and requires a large amount of time and labor, hence amid the multitudinous duties pressing in other directions, progress is necessarily slow.

The prune has been selected for the first work since at the present time it is demanding a large share of attention in the state, and is undoubtedly to be one of the leading fruits of the Northwest. The work here presented is far too meagre to serve as the basis for broad conclusions, but there is a sufficient number of analyses to serve as an indication of the condition of our fruit. It is hoped by the continued study of the proximate and ash composition of the various fruits, and their varieties, to determine something of value as to their relative merits as food, and as to the influence of climate, soil and fertilizers upon them. The question of soil exhaustion is bound to be a burning one, and by "taking time by the forelock," we hope to show the lines of heaviest draught upon soil ingredients. This together with a study of the soil capabilities is of the utmost importance to the horticulturist. Again, the question of food composition is rapidly orcing itself to the front, and ere long

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TABLE III

Showing Analyses of Fresh Prunes.

Laboratory No.	Variety.	Grower.	Locality.	Average Weight in Grams.	Number per Pound.	Per Cent of Flesh.	Per Cent of Pits.	FLESH. Per Cent of Juice, Pressed.	FLESH. Per cent of Pulp.	SUGAR. In Fresh Flesh.	SUGAR. In Juice.	SUGAR. In Fresh Fruit.	Acidity in Juice, Terms of SO_3	Nitrogen in Flesh.	Albumenoids in Flesh. N x 6.25	PROXIMATE COMPO'N. Crude Ash.	Water.	Organic Matter.	Crude Ash.	Total.	Laboratory No.
579	Italian	Wm. Hartless	Corvallis	29.5	15.4	97.29	2.71	75.8	24.2	14.04	18.55	13 66	.43	.212	1.33	1.63	74.2[illegible]	24.09	1.63	100	579
580	Petite	H. F. Fisher	"	30.5	14.8	95.08	4.92	73 5	26.5	17.52	23.02	16.66	.61	.265	1.66	.45	75.26	24.29	.45	100	580
581	Silver	"	"	47.8	9.5	95.29	4.71	75.5	24.5	10.26	13.59	9.77	.42	.257	1.61	.57	81.43	18.00	.57	100	581
582	German	S. Whiteside	"	16.7	33.7	95.38	4.62	75.0	25.0	8.16	10.90	7.70	.38	.153	.96	.69	79.40	19.91	.69	100	582
584	Italian	John Hall	"	36.6	12 4	93.01	6.99	61.0	39.0	12.92	21.28	12.01	....	.181	1.13	.87	77.89	21.24	.87	100	584
585	Petite	"	"	29.2	15.5	92.17	7.83	78.6	21.4	16.42	20.89	15.13	.67	.233	1.56	.67	74.11	25.22	.67	100	585
586	Italian	J. D. Johnson	Corvallis	31.5	14.4	95.28	4.72	68.2	31.8	11.44	16.77	10.89	.92	.170	1.06	.88	75.34	24 78	.88	100	586
587	Petite	E. Witham	"	23.0	19.7	92.00	8.00	75.0	25.0	8.90	11.86	8.19	.65	.233	1.56	1.02	83.41	15.57	1.02	100	587
588	Silver	D. C. Rose	"	57.0	7.9	93.18	6.82	63.2	36.8	15.16	23.97	14.03	.65	.170	1.06	1.07	69.01	29.02	1.07	100	588
720	Petite	J. K. Shepard	Zena	17.7	25.7	92.60	7.40	75.7	24.3	15.08	19.79	14.04	.35	.200	1.24	.63	77.70	21.67	.63	100	720
721	Italian	"	"	32.1	14.2	94.56	5.44	70.2	29.8	8.52	12.13	8.08	.37	.....	.....	1.01	69.92	29.07	1.01	100	721
722	Silver	"	"	36.3	12.4	92.77	7 23	83.0	17.0	14.80	17.83	13.80	.29	.....	.....	.71	77.58	21.71	.71	100	722
733	Petite	"	"	24.2	18.7	94.12	5.88	80.0	20.0	16.54	20.67	15.61	.24	.....	.....	.....	.....	.....	.....	.....	733
742	Italian	G. A. Hobbs	Freewater	.....	.....	.....	.....	73.4	.....	14.03	17.52	.....	.4[illegible]	.....	1.32	.85	76.35	22.80	.85	100	742
743	Italian	Geo. Thompson	McMinnville	.....	.....	.....	.....	.....	.....	12 38	.....	.....	.49	.229	1 37	.....	.....	.....	.....	.....	743
744	Silver	C. L. Dailey	Salem	.....	.....	.....	.....	.....	.....	14.58	.....	.....	.30	.200	1.25	.....	64.31	.....	.....	.....	744

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properly balanced rations will demand the careful attention of the housewife. The physical data as to pits, flesh, juice, etc., from a commercial standpoint, and the albumenoids and sugar content, the nourishing parts of the fruit, render it important to the consumer to know the relative merits of varieties, and no less is this true of the producer, who should be made aware of the real worth of the fruit he grows. It is only in this way that the special merits of fruit grown in different localities can be determined. Further it is proposed to examine the different methods of curing the fruit, which is of itself worthy of consideration, for to be able to produce a better quality and quantity of fruit may mean the difference between profit and loss to many a man. To illustrate, if it is possible to demonstrate that for every 100 lbs. of fruit now cured by a certain method there would be a gain of no more than 5 lbs. by the exercise of particular care in certain lines it would return, many times over, the cost of the work. Thus the question of the composition and curing of fruit is not of minor interest either from a scientific or economic standpoint, but is one of paramount importance to the industry.

The accompanying table shows the composition of some Oregon prunes as analyzed at the Station.

Notes on the Analyses.

WEIGHT OF PRUNES.—The range of all prunes examined is from 16.7 grams in No. 582 to 5.70 grams in No. 588. The average weight of the Petites was 24.9 grams. This is against 23.6 grams, the weight of California French prunes so far published. Thus the Oregon French prune requires 18.2 prunes for a pound while those of California require 20.4. The average weight of the Italian prunes was 32.4, which would require 13.4 prunes for a pound. Italian prunes No. 584, from the Umpqua valley are worthy of notice on account of their large size; and they are also significant on account of the size of their pits, which constitutes more than one-fifth the weight of the prune. It will be interesting to watch future work as to whether all prunes of that region are characterized by these same features.

PROPORTION OF PITS TO FLESH.—The percentage of pits ranges from 2.71 in Italian No. 579 to 8.co in Silver No. 587. The average for the Petite prune, 6.81 per cent, indicates that the fruit contains about 14 times as much flesh as pits. The

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California analyes show a little smaller pit, making the per cent of flesh about 3 per cent higher. The California prune approaches more nearly the European in this respect, for the average pit percentage for the European fruit is 5.4. After further investigation 14 may be found too low a number to express this relation of flesh to pits, yet it is hardly probable that it will be changed so much as 3 per cent. The Italian prune seems to carry about 19 times as much flesh as pits, making them so far as the *amount* of flesh is concerned much the more economical fruit. At this point it is interesting to refer again to analysis 584, and recalling the large size of these prunes together with their large pits, and to note that the proportion of flesh to pits is as 13 to 1 while the average for Italians was as 19 to 1. I deem it to be the more interesting to follow future analyses from this locality closely since the exceptionally large and apparently well developed fruit from that region has attracted much attention, and it is popularly supposed to be the best region in the state for prune culture.

PROPORTION OF JUICE TO FLESH.—The largest proportion of juice is shown by the French prune, the average being 75.5 per cent, exceeding the Italian by about 9 per cent.

THE SUGAR AND ACID CONTENT.—The chief interest in prunes centers about the sugar and nitrogen content. The honors can be divided about equally between the California and the Oregon fruit, for the former evidently excels in sugar and the latter in nitrogen. An examination of the table shows the average sugar content for all prunes analyzed to be 17.52 per cent *in the juice*, or 14.03 per cent in the flesh, or edible part. The soft-fleshed French prune shows 2.21 per cent more sugar in the juice than the average for all prunes, i. e., 19 25 per cent against 17.52 per cent, and a difference of 2 per cent in favor of the French over the Italian, which contained on an average 17.18 per cent sugar in the juice. It is regretted that data is not at hand to indicate the difference in the sugar content of early and late picked Petites. Some indications may be had from the following little table showing the composition of ripe and unripe prunes when dried. These prunes were selected of about the same size, and those marked *ripe* were such as fell from the tree after a *very gentle* shake, while those marked *unripe* required a *very vigorous* shake to remove them. The flesh of the former

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was just beginning to soften, while that of the latter was still quite hard and unyielding. The two samples were dried in the same tray at the same time, and contained respectively when dried 18.82 and 18.47 per cent of water.

Ripe fruit (735) contained 25.60 per cent sugar in flesh.
Unripe fruit (734) " 19.18 " " " " " "

Analysis of the undried prunes from which the above samples were taken showed them to have a much lower sugar content than the average Petite, and it will be noted that the sugar content of the dried product is very low as well, yet the analyses serve to illustrate what may be expected from drying prunes, when too green. Neither of the samples were sufficiently ripe, and do not represent what should be expected of well ripened prunes when correctly dried. Such prunes should carry at least 10 per cent more sugar than the best of the above mentioned, (735).

There is still another reason, one which appeals more directly to the financial side of the case, why the fruit should be allowed to become thoroughly ripe. This lies in the fact that 100 lbs. of ripe fruit when dried will yield a greater per cent of the dried product than will unripe fruit. This is well illustrated by results obtained in drying the prunes mentioned above.

TABLE IV.

Lab. No.	Condition.	Lbs. used.	Dry Fruit obtained.	Lbs. Dry from 100 lbs. Green.	Hours Dried.	Water
734	Unripe	5	1.75	35	23	18.47
735	Ripe	5	2.00	40	24	18.82

That the importance of observing this simple precaution in the drying of prunes may be the better appreciated attention is directed to the following figures: Assuming that the above figures represent average amounts of fruit obtained under the conditions given, and that an average yield of a mature orchard is 12,000 lbs., the saving of this small amount on the product of an acre would be 600 lbs. of dried fruit, which at 5 cts. a lb. represents a saving of $30 for each acre, a sum not to be ignored by any means, even if the results in future experiments should lessen it by one-half.

The California Reports show the French prune to contain on an average (13 analyses) 23.69 per cent sugar in the juice, indi-

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cating a difference in average sugar content in favor of the California fruit of about 4 per cent. The average sugar content of all analyses (13) is related to those of California as 17.52 to 20 per cent in the juice. From the difference in the climatic conditions, we might expect, *a priori*, such a difference to occur.

While it is possibly no positive injury to Oregon prunes to to be characterized by a distinct tartness, yet care should be exercised that this is not unnecessarily increased. The tartness may be reduced to a minimu n by seeing to it that the fruit is thoroughly ripe before drying. After careful observation and experiment I am satisfied that it is an altogether too common practice to dry prunes before they are sufficiently ripe, thus securing a prune which is not only of low food value, but also of increased tartness. Carelessness in this direction will tend much to lower the standard of Oregon prunes in the market, and cause them to lose the position they might otherwise occupy.

Contrasting the Oregon fruit with 17.52 per cent sugar in the juice with that of Germany carrying 6.15 per cent sugar, we see that the prune product is nearly 3 times as rich in this ingredient. In this respect the sample of German prune, No. 582, is significant in carrying 10.90 per cent sugar in the juice, which is 4.75 per cent higher than the average of all prunes for Europe.

In the acid content the prunes examined present a wide variation. The average acidity in terms of sulfuric acid was found to be .46 per cent.

ALBUMENOIDS.—This is a class of bodies which contain about 16 per cent of nitrogen, and which in all ordinary analyses is determined from the nitrogen content by multiplying it by 6.25. It is the function of this class of bodies, and of this class alone, to form flesh or muscle in the animal body. So far as we know none of this material is elaborated in the body, but must all be obtained from external sources, hence the great importance of the albumenoids in any article of food.

Referring to the table, the maximum, 1.66 per cent of albumenoids, will be found in the Petite, No. 580, and the minimum per cent, .96, in the German, No. 582. The average for Petites was 1.50 per cent against 1.20 per cent in the Italian, and 1.30 per cent for Silvers (in the case of Italian and Silver inclusive of of one analysis each not given in the table because incomplete).

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Nos. 580 and 585 are particularly rich in these ingredients. In this connection it is interesting to note that the report of the California products show as an average of 20 analyses .837 per cent albumenoids in the flesh against 1.32 per cent for Oregon fruit. No analyses showing the albumenoids in the edible portion of European prunes is at hand, but in the whole fruit there is reported .78 per cent.

It is indicated that Oregon prunes carry *double* the albumenoids contained in the European product, and have a somewhat higher per cent of this ingredient than the California product. This is evidently one of the strongest points of the Oregon fruit, and as the study of human foods progresses in the United States will tend to bring our fruit into greater prominence.

Food Value of Prunes.

Below is given a table showing the average food constituents of the prunes so far analyzed.

TABLE V

Showing Food Constituents in the Edible Portion of Oregon Prunes.

CONSTITUENTS.	Petite.	Italian.	Silver.	German.	Average.
Water	77.62	74.33	76.31	79.40	76.35
Solid Matter	22.38	25.67	23.69	20.60	23.65
Total	100.00	100.00	100.00	100.00	100.00
Sugar	14.89	11.75	13.70	8.16	14.03
Albumenoids	1.50	1.20	1.30	.96	1.32
Crude Fiber Fat Nitrogen-free Extract	5.04	11.16	7.61	9.59	6.99
Ash	.69	1.02	.78	.69	.85
Acid	.26	.54	.30	.20	.46
Total	22.38	25.66	23.69	20.60	23.65

An examination of this table indicates that the French prune exceeds the Italian in water by about 3¼ per cent, and that it leads in albumenoids, or flesh forming matter, the Italian carrying less of this substance than either the Petite or Silver. On the side of carbohydrates, of which sugar is the principal ingredient, the Petite also leads with 14.89 per cent in the edible portion. In relation to the distribution of nitrogen in the *whole* fruit, concerning which we have made no investigations on account of pressure of work in other lines, I quote:* * * * * * "The flesh holds 85 per cent of

*California Station Report, 1892–1894.

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all the nitrogen, leaving 15 per cent of it as waste,' so far as food values are concerned. Second, the proportional distribution of nitrogen in the pits of the prunes and apricots to the kernels and shells rate on the whole about the same (12 to 1) although we note great variation in this respect in both fruits."

Below a table is given showing the food constituents of 13 samples of dried prunes, all but the last two of which are Petites, Nos. 746 and 747 being Silver prunes.

TABLE VI

Showing Composition of Dried Prunes.

Laboratory Number.	Water.	Albumenoids.	Ash.	Sugar.	Other Carbohydrates.	Acid, as SO_3	Total.
724	22.45	2.38	2.83	23.76	48.02	.56	100
726	19.22	1.94	2.03	.....	.....	.28	100
728	20.11	2.38	2.12	29.64	45.40	.35	100
729	21.46	1.41	2.21	36.66	37.86	.40	100
730	21.03	1.94	2.92	24.74	49.05	.32	100
731	19.75	1.56	2 42	31.26	44.62	.39	100
734	18.47	2.12	2.62	19.18	57.29	.32	100
735	18.82	1.37	3.02	25.60	50.87	.32	100
736	16.85	2.00	2.52	28.55	49.80	.28	100
741	25.82	2.43	1.58	27.36	42.49	.32	100
745	18.84	2.00	2.05	22.92	54.01	.18	100
746	26.68	2.62	1.78	16.42	52.25	.25	100
747	27.49	1.68	1.86	18 06	50.94	.29	100

In examining these results it must be distinctly understood that they are in all respects preliminary, and are recorded as indications which are very likely to need more or less modification as our work progresses.

ASH AND ITS COMPOSITION.—Among the most important considerations concerning any crop is the composition of the ash, for the constituents of the ash represent the draught upon the soil. An article recently appeared in the "Rural Northwest" from which I quote:

"There is no doubt that the many failures in fruit production in the East are largely due to the exhaustion of important elements of plant food in the soil. All farmers realize the importance of keeping up the fertility of the soil for the production of their annual crops of grain and vegetables, but somehow the idea has been prevalent that a tree can take care of itself. Men look at the great trees of the forest and see how they grow and how the soil increases in fertility under their influence, and think that the same should be the result in the growing of fruit trees, while they are carrying

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off continually, not only the fruit that the orchard produces, but in many cases expect the land also to produce food for their stock. And then, when the orchard fails to give the expected fruit, and its decrepit condition makes the trees alike the prey to insects and fungous diseases, they declare that the climate has changed and we can no longer produce crops for that reason. It has really been because they and their fathers have robbed the soil until the needed food for the production of healthy trees and perfect fruit is no longer available."

It is essential to future prosperity, then, that careful study be made as to the draught not only of our prunes but also the other fruits on the soil of the state. Work in this direction has progressed sufficiently to say that the Petite prunes carry less than the average per cent of potash—about two-thirds as much as the California fruit. When the condition of our soils as set forth by the writer elsewhere in this Bulletin is considered this low content of potash in the ash is not at all surprising. Again the phosphoric acid content of the ash is in excess of the average of prunes elsewhere.

This matter will be treated more at length in a future publication for which experiments are now in progress.

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INSECTS OF THE PRUNE.

By A. B. CORDLEY, Entomologist.

THE PRUNE, wherever grown in the United States, has been unusually free from insect injury. Nearly or quite two hundred kinds of insects feed upon the apple. Probably half as many feed upon the pear, or peach, or cherry, and yet scarcely a score of species are known to feed upon the prune. The apple has its codling moth, its woolly aphis, and its green aphis. The pear has its blister-mite and its pear-tree psylla. The cherry has its slug and the plum its curculio; but fortunately no insect has as yet established a claim to being distinctively classed as a serious prune pest.

There is no good reason, however, for hoping that this immunity from insect injury will long continue. Prunes have been grown extensively in Oregon only within recent years; hence there has been no opportunity for the rapid multiplication of insects that feed upon it— no opportunity for those species which may have accidently acquired a taste for the various parts of the tree, or for the fruit, to transmit that taste to any great numbers of their progeny.

So soon, however, as any crop is grown extensively in a given locality, experience has shown that, in their intense struggle for existence, native and introduced species of insects will be driven to acquire the habit of feeding upon it, and some of them will eventually multiply to such an extent as to become more or less serious pests. Such has been the history of insect depredations upon numerous other crops, and there is no good reason for hoping that the prune is to be an exception.

Already, scattered reports begin to come in from different parts, of more or less serious injury from insects that. hitherto, have not been known to feed upon this plant. Even within our own state several species have become quite generally injurious,

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while others are doing more or less serious damage in certain localities.

In view of the above facts, it has been thought best to conclude this Bulletin with a preliminary report on prune insects, in order that the grower may be enabled to recognize some of the worst pests as soon as they appear upon his trees, with the hope that it may aid him in subduing their attacks, and that it may create an interest in the subject which may lead to many new and important observations in the future. We expect to continue our investigations along this line, and sincerely hope that every one interested in prune-growing will aid, by sending to us any insects they may find injuring either the tree or the fruit of the prune.

For the greater convenience of those who may wish to refer to the following pages, the insects have been classed under the following heads:

A. Insects injuring the roots, Nos. 1 and 2.
B. Insects injuring the trunk, Nos. 1, 2 and 3.
C. Insects injuring the branches, Nos. 4, 5 and 6.
D. Insects injuring the leaves, Nos. 7, 8, 9, 10, 11 and 12.
E. Insects injuring the fruit, No. 13.

No. 1. The Peach-Tree Borer.

Sanninoidea exitiosa, (*Say*).

This insect, which promises to be one of the very worst insect enemies of the prune, is the well known Eastern Peach-tree Borer. It was first described by Mr. Say nearly seventy-five years ago under the name *Aegeria exitiosa*.* Several years ago the species was transferred to the genus *Sannina*, since when it has been known as *Sannina exitiosa*. Recently, however, Mr. Beutenmuller, who is making a critical study of the North American Sesiidae, has concluded that the species should form the type of a new genus, *Sanninoidea*,† so that henceforth this insect will probably be known scientifically as *Sanninoidea exitiosa*, (Say).

Prevalence in Oregon.

My attention was first called to the work of the borer upon prunes very soon after I arrived in the state, by Mr. Brady Bur-

*Jour., Phil. Acad. Nat. Sci., Vol. III, p. 216, 1823.
†Bul. Am. Mus. Nat. Hist., Vol. VIII, p. 126, 1896.

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nett, a graduate student in entomology, who, early in October, 1895, brought me a number of the larvæ of various sizes that he had taken from prune trees just south of Corvallis. Since then, observation in different parts of the state, and numerous letters of inquiry from various localities show that it is widely distributed at least in Western Oregon.

Under date of July 27, 1896, Mr. C. L. Dailey, Horticultural Commissioner for the Second District, wrote me as follows:

"I find in my district that the Peach-tree Borer is doing a great deal of damage to prune trees—it seems to make no difference whether the trees are grafted on peach or plum stock. As old a pest as this is and as familiar as I am with it, I find very little authentic information has been published as to its life cycle and description. I am not convinced that the borer, that we have here to contend with in our prune trees, is the same as the Peach-tree borer of the East. They are serious this year and I should like more definite information regarding them."

Aug. 8, 1896, Mr. Dailey sent me specimens of the larvæ and pupæ of this insect and wrote:

"We are cutting out as high as twenty larvæ from a single tree. They have done a world of damage. Many trees will die. *The trouble is mostly with my Silver prunes, the Italians not nearly so bad.* The trees have been "grubbed" every year, but I have never seen them so badly infested as now."

Aug. 19, 1896, Mr. R. V. Pratt wrote from Lookingglass, Oregon:

"I have now inspected some 4000 out of 6000 trees. We have found several hundred trees infested by this pest. In quite a number they have penetrated the heart of the tree and it breaks easily when bent. Many of t e trees have been entirely girdled and will die. I found from one to six "grubs" in a tree. *About all the damage is to the Italians.*

The above extracts from my correspondence, together with the fact that during a recent visit to Southern Oregon, the borer was found doing considerable injury to both peach and prune trees, and a recent examination of about 1200 trees about Corvallis, revealed that nearly ten per cent of them were infested, are sufficient to show the injury being done to prune orchards by this pest.

Introduced into Oregon.

Just when and where the peach-tree borer was introduced into Oregon is not known, but it probably made its first appearance at Salem nearly twenty years ago. Mr. S. A. Clark, who has been so long and intimately connected with the fruit interests of the state, writes as follows:

"My first acquaintance with them was about 1881, when I purchased trees from a local nursery. I found, when too late, that they were infested."

Mr. J. H. Settlemier & Son, proprietors of the Woodburn

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nurseries, write that to the best of their knowledge the borer was introduced near Salem about 1880. They write:

"It is presumed that they came in trees from eastern nurseries, as at that time there were quite a few trees sold here from nearly all the large eastern establishments."

Is Spreading Rapidly.

Although this borer has been present in Oregon nearly a score of years, yet as Mr. Dailey says, very little authentic information has been published regarding it. What few references there are to it, in the horticultural literature of the state, would lead one to infer that only within the last two or three years has it attracted attention as a prune pest, and when viewed in the light of our recent observations, show conclusively that it is multiplying and spreading very rapidly in prune orchards.

Prof. F. L. Washburn mentioned it as "one of the worst pests with which Oregon orchardists have to contend," and adds that in addition to peach trees, "cherry trees and plum trees sometimes suffer from their attacks."* In a later publication he states that it is abundant, but under the head of plants injured mentions only peach trees.† Mr. Varney writes that it is "quite troublesome" in some localities, but lists it as the peach-tree borer and does not mention that it injures other trees.‡ In a still later publication, Prof. Washburn evidently refers to the prune in the statement that the moth "lays its eggs on the plum, cherry, and peach trees (*or peach stock whatever the tree may be*).§ Mr. E. W. Allen refers to it in a short illustrated article and states that "it also works on the plum."|| At the time the Third Report of the State Board of Horticulture was issued (1895) the borer seems still not to have been recognized as a serious enemy of the prune, since the only reference to it is to cite readers, who desire information, to the First and Second Reports. In his last publication as Station Entomologist, Prof. Washburn makes the first definite reference to the work of the insect upon prunes in Oregon, that I have been able to find, stating under the head of "Prune Insects" that "the peach-tree borer is a troublesome pest wherever any tree is grafted on peach or plum stock."¶ Mr.

*Bul. No. 5, Ore. Expt. Sta. 1890.
†Bul. No. 14, Ore. Expt. Sta. 1891.
‡First Biennial Rpt. Ore. State Bd. of Hort., 1891, p. 27.
§Bul. No. 18, Ore. Expt. Sta., 1892.
||Bul. No. 5, Ore. State Bd. of Hort., 1891, p. 76.
¶Bul. No. 38, Ore. Expt. Sta., 1895.

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C. L. Dailey has recently written that "the worst insect pest of the prune and peach trees in the Willamette valley and probably over the entire state is the peach-root borer."*

Description and Life-History.

The adult insects are beautiful wasp-like moths, the males and the females of which differ so much that they are readily mistaken for entirely different species. They are from one half to three-fourths inch long, and have a wing expanse of from four-fifths to one and one-half inches.

The body of the female (Plate V, *a*, Fig. 1.) is deep steel blue in color, with the fourth and sometimes the fifth segment of the abdomen, orange. The fore wings are of the same color as the body, while the hind wings are clear, transparent, bordered by a band and fringe of deep blue, and with a few scales of the same color at the base and along the front margin.

The male (Plate V, *b*, Fig. 1.) is somewhat smaller than the female, has small flecks of yellow, upon head and thorax, the second, fourth, fifth and sixth segments of the abdomen are narrowly banded with yellow, and all four wings are transparent, with a narrow border and fringe of steel blue.

TIME THE MOTHS APPEAR.—I have no direct evidence concerning the time of year at which the moths appear in Oregon; but a large series of larvae collected in October contained specimens varying in size from those not more than one-fourth grown to those fully grown. This indicates that the period of egg deposition extends over a considerable time, thus corresponding with the well known habits of the insect in the East, where the moths are known to continue to issue and deposit eggs, from early in May until the first of October. We may safely infer that any time between May and October, these beautiful wasp-like moths are flying about in the bright sunshine depositing eggs upon the bark of prune and peach trees.

THE EGG.—These eggs are scarcely more than one-fiftieth of an inch long by half as broad, and are nearly oval in shape. They are usually deposited at or near the surface of the ground, but occasionally one occurs high on the trunk or even on the lower branches. They are deposited singly and are stuck to the outside of the bark by a gummy substance, no effort being made

*Fourth Biennial Rept. Ore. State Bd. of Hort., 1897, p. 133.

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by the moth to secrete them in crevices of the bark as is generally supposed.

THE LARVÆ.—The eggs in a few days hatch into very minute and very active larvae which immediately bore into the bark, usually entering through some minute crack. Having once entered the inner layer of bark the larva bores downward until it is just beneath the surface of the ground, where it remains feeding upon the inner bark and sapwood throughout the remainder of the season. During the winter it remains dormant in its burrow, but on the opening of spring commences to feed and continues to do so until fully grown. In the case of the larger ones this is only for a short time, but the smaller ones undoubtedly continue their injury until well past midsummer.

A recent examination of some twelve hundred trees has shown that at this season of the year (April) larvae can be found in all stages of growth from those not more than one-fourth inch long, to those nearly or quite fully grown. They are yellowish white in color, nearly cylindrical, the head and first segment is brown, and when fully grown, they are about one inch long. (See Plate V, *c*, Fig. 1.)

THE PUPA.—When grown the larva usually leaves its burrow, enters the ground and builds from its own frass and particles of bark held together by silken threads, an elongate cell or cocoon in which it transforms to a rather slender brown pupa. (Plate V, *d*, Fig. 1.) Although no pupae have been found as yet this season, a number of fully grown larvae were present, in the soil at the base of the trees, where they had evidently begun to construct their cocoons. From this fact it is inferred, since the pupal stage lasts but a few days, that the earliest moths emerge in this locality not far from May 15th, and since larvae in all stages of growth can be found it would seem that they will continue to pupate, and to emerge as moths throughout the summer.

Injury Done.

In badly infested trees, the larger roots and even the base of the trunk may be entirely girdled and the tree greatly injured or even killed outright. The presence of a borer in a tree is always indicated by a mass of jelly-like gum mixed with sawdust-like castings about the base of the tree, at or just beneath the surface

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of the ground, or at least by the presence of the sawdust-like castings.

So far as our observation goes all varieties of prunes are alike attacked, irrespective of whether they are grown upon peach or plum stocks. Mr. Dailey states that they have injured his Petites most; Mr. Pratt, that in his orchard the Italians are worse affected.

Preventives and Remedies.

All successful means of preventing injury from these borers are based upon the fact that the moth deposits her eggs upon the outside of the bark, and the young larvae when hatched are compelled to eat their way into the tree from the outside. Bearing this fact in mind it is evident that any application to the tree during the summer months, that will prevent the moth from depositing her eggs upon the bark, or that will poison or otherwise destroy the young larva at the beginning of its career, will prove perfectly effective in preventing all injury from these borers.

Many methods have been employed to accomplish these results, all of which can be conveniently grouped under two general heads, viz., (1) mechanical protectors; and (2) various destructive washes.

Mechanical Protectors.—Several kinds of tree protectors, warranted to prevent all injury from borers and other pests, have been placed upon the market. Some of them are very effective; but for cheapness and efficiency there is probably nothing better than to wrap the base of the tree with a band of heavy paper eight or ten inches wide. The earth should be removed from about the base of the tree, the wrapping applied so that it will extend two or three inches below the surface of the ground, and the soil replaced. Care should be taken to confine the wrapping closely to the trunk with strings, otherwise the moth is liable to crowd in and deposit her eggs upon the bark. Instead of paper, a wrapping of straw may be used successfully if care be taken to leave no crevices through which the bark is exposed. At first thought this process would seem to be very expensive, but Mr. Dailey, who has wrapped a very large proportion of the trees in his thirty-five acre orchard, tells me that

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the expense is almost nothing as compared with that of cutting the grubs from unprotected trees. He found that with a little experience one man could wrap 600 trees per day, and that the expense for material is very slight indeed. The total cost of wrapping his trees was about sixteen dollars, whereas he had just previously expended nearly three hundred dollars in "worming" the same trees. It is hardly necessary to add that his trees will be protected by wrappers in the future.

WASHES.—Various washes are used to prevent the moth from depositing her eggs, or to coat the bark with a substance impenetrable to the larva, or to destroy it before it has penetrated the bark.

For the first purpose Dr. Lintner recommends a wash made by mixing one pint of crude carbolic acid in one gallon of soft soap, then diluting with eight gallons of water.

For the second purpose probably no wash is better than a good stiff whitewash, to which a little glue has been added to make it more permanent and impenetrable, while for destroying the young larvae nothing is better than some poison, applied with some substance that will make it stick to the bark.

For all practical purposes the combined effect of all three of the above washes may be obtained by using a good whitewash to which has been added a little glue, a small amount of carbolic acid, and a little Paris green. Use about one pint of the acid and two or three ounces of Paris green to each ten gallons of whitewash, and apply the mixture thoroughly with an old broom or good stiff brush. The application should be made between the first and fifteenth of May, and should be repeated whenever it appears that the coating is becoming imperfect. We are of the opinion that this is, withal, the cheapest effective preventive of injury from the peach-root borer.

REMEDIES.—The above mentioned measures are only preventive. When once the larva has entered beneath the protecting cover of the bark and exuding gum it is beyond the reach of any external application of insecticide substances. The only satisfactory remedy then, is to examine the trees carefully, once in the fall and again in the spring, remove a little of the dirt from the base of the tree, and whenever the presence of a borer is indicated by the exuding gum or sawdust-like castings, cut it out. It is then a

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good plan to prevent decay by covering the wound with grafting wax.

Even with experience, this method of controlling the root borer is quite expensive, and should be employed only as supplementary to one of the preventive measures above described. At best it removes the borer only after the injury is done and then only at the expense of a more or less serious wound to the tree. First use one of the preventive measures, then if an occasional tree becomes infested use the knife.

Various other methods of destroying the borer have been recommended. Apparently good results have been obtained by scooping out a shallow basin about the base of the tree and filling it with hot water, while others by using a small oil can, or similar device, inject a small quantity of kerosene oil or bisulphide of carbon into the burrow made by the borer, and report that it is effective.

All of these methods, however, are fully as expensive and troublesome as the "knife remedy" and have the disadvantage that one leaves the tree not knowing that the work has been effective.

No. 2. The Pacific Peach-Tree Borer.

Sanninoidea opalescens (Hy. Edw.)

This insect is undoubtedly present in the state, and in fact may very largely take the place of *S. exitiosa* in Southern Oregon, where it seems to have been introduced from California between ten and fifteen years ago.

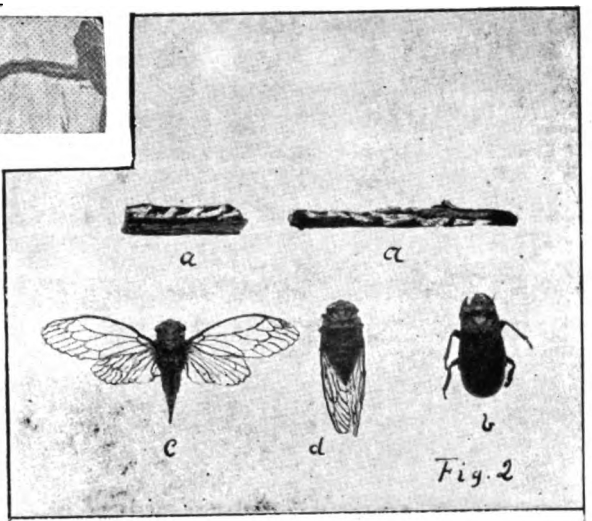
It so closely resembles the latter, however, both in general appearance and in habits, that it is unnecessary to speak of it in a work of this kind other than to state that the same preventive and remedial measures that have been recommended for the eastern peach-tree borer, will prove equally effective against its western relative, except that the latter is somewhat more difficult to remove with the knife, since it frequently bores more deeply into the solid wood.

It is probable that the letter of Mr. R. V. Pratt, above cited, refers to the work of this insect where it states that "they had in many cases penetrated the heart of the tree." The larvae of *S. exitiosa* confines itself almost entirely to feeding upon the inner bark and sapwood.

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Fig. 3.



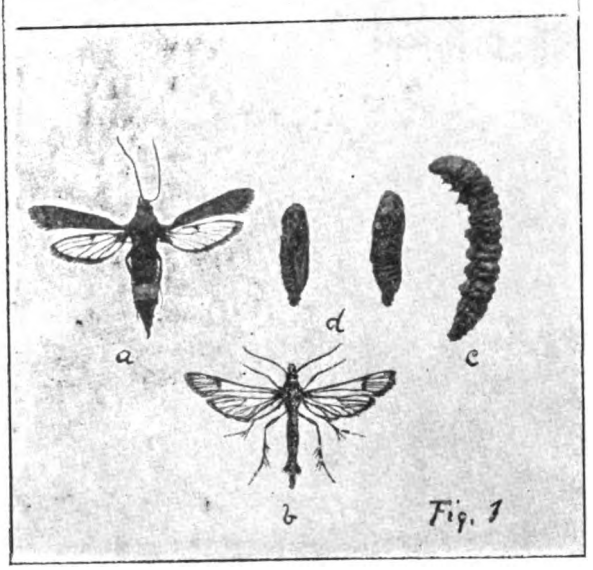


FIG. 1, *Peach-Tree Borer.* FIG. 2, *Cicada.*
FIG. 3, *Work of Flat-Headed Apple-Tree Borer.*

PLATE V.

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No. 3. The Flat-Headed Apple-Tree Borer.

Chrysobothris femorata (Fab.)

In addition to injuries by both of the above mentioned root-borers, trunks of prune trees are sometimes attacked by the larvae of this well known apple-tree pest.

During the last two years I have received several reports of such injury by this insect, and have recently received from Mr. Julius Priester, of Oregon City, a section of the trunk of a young prune tree containing a borer which I have been able to identify as the larva of this insect.

Description and Life-History.

The adult insect, *d*, Fig 1, is a beetle belonging to the family *Buprestidae*, to which many of the worst enemies of fruit and shade trees belong. It is nearly ½ inch long, flat and rather oblong in shape, and is of a greenish-black color above with the surface uneven, but polished and shining. Beneath it has a brilliant coppery lustre.

The beetles are most abundant in neglected orchards where they may be seen running actively about on the tree trunks in the bright sunshine of a May or June day.

Although most commonly known as a pest of the apple they originally worked upon the oak, and in addition are also known to attact the soft maple, willow, mountain ash, box elder, linden, peach, pear, cherry, and prune.

When working upon fruit trees the female usually selects one that has been injured by sun-scald or by "winter killing" or that is for some other reason unthrifty, and deposits her eggs under the loose scales or in the crevices of the bark, fastening them in position with a glutinous substance. Usually only one is deposited in a place, but occasionally several are placed together in a group. A small tree trunk, about four inches in diameter and three feet long, that is before me, shows the work of no less than fifteen of these borers. Plate V, Fig. 3, shows one of the burrows near the origin of which are the beginnings of two similar ones.

The eggs soon hatch and the young larvae, after boring through the outer bark, continue to feed upon the sapwood, the burrows gradually becoming broader and broader as the larvae in-

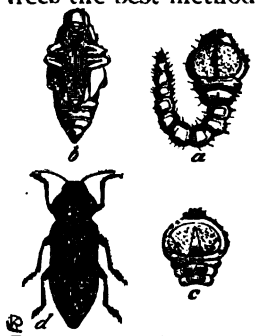
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crease in size. One such borer may completely girdle and kill a small tree, and several of them will greatly injure or even kill trees of the size above mentioned, or even larger. When fully grown each larva bores deeply into the solid wood, or at least excavates a chamber or cell in which it changes to the pupa shown at *b*, Fig. 1. Just before the change, it is about ¾ of an inch long and its head and anterior segments are enormously developed. Its characteristic appearance is well shown at *a*, Fig. 1.

Dicerca divericata (Say), another borer very similar to the above, but somewhat larger, has also been reported by Prof. F. L. Washburn as occasionally injuring the prune.*

Preventives and Remedies.

Since these insects rarely attack perfectly healthy vigorous trees the best method of preventing injury is to insure such trees by extra care and cultivation, by preventing so far as possible all injury from "sunscald" and "winter killing" by shading the trunks of young trees with a piece of board or something similar stood upright in the ground by the south-west side of the tree, or by wrapping them as for the peach-tree borer. However, trees that are not vigorous or that have been injured in any way may be effectively protected from borers by applying the poisoned whitewash or the wrapping recommended for the peach-tree borer. They should be applied for this purpose about the middle of May.



Flat-headed Apple-tree borer. a *larva*, b *pupa*, c *head of borer*, d *beetle.*
FIG. 1.

No. 4. Cicadas or Harvest Flies.

Platypedia putnamii Uhler.†

One of the injuries to prune branches most often referred to the Entomologist is shown at *a*, Fig. 2, Plate V. It consists of a conspicuous irregular double row of punctures in the bark, through each of which a small "brush" of splintered wood protrudes. This injury is caused by a female cicada in the act of depositing her eggs. These insects are closely related to the celebrated seven-

*Bul. No. 38, Ore. Expt. Sta, p. 19.
†Determined by Mr. C. F. Baker.

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teen-year "locust" which occasionally does such serious damage to fruit and forest trees in the Eastern States, but differs from that insect in several respects, the most important of which is the fact that, whereas, that occurs in a given locality only once in seventeen years, our native species occurs annually.

The young, or *nymphs*, (*b*, Fig. 2, Plate V) of this insect live entirely under ground and do no appreciable harm. When fully grown they emerge from the ground, ascend trees or other objects and soon become firmly attached. In a short time the skin splits down the bark and the adult insect (*c*, Fig. 2, Plate V) emerges.

After pairing, each female resorts to some tree and proceeds to deposit her several hundred eggs. Selecting a suitable twig, with her strong saw-like ovipositor she makes a ragged double puncture in it, and deposits an egg in each. Then moving forward she repeats the operation. This process is continued until a row of perhaps a dozen punctures have been made, when she repairs to another twig and repeats the operation. One female may thus injure a large number of twigs before her supply of eggs is exhausted.

The wounds made by this process are almost invariably found on twigs not more than one-half the diameter of an ordinary lead pencil, and so weaken them that they are easily broken by the wind during the first or second season. If this does not occur no serious injury is done, since the young cicadas as soon as hatched drop to the ground without working upon the tree at all.

Fortunately these insects are not numerous, and a very large proportion of their eggs are deposited upon other than fruit trees. It is the conspicuous nature of the injuries, rather than their frequency, that brings them so prominently before the attention of orchardists. There is, however, no cause for alarm, and no remedial or preventive measures need be employed, unless the attacks become much more serious than they have yet been. It is usually recommended to cut off and burn the freshly punctured branches, but since the injury itself would not do more than cause the loss of the twig, and since the very few eggs destroyed would not preceptably diminish attacks in the future, I do not see the necessity for such a course. *d*, Fig. 2, Plate V represents a less common species with wings folded.

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No. 5. The Branch and Twig Borer.

Polycaon confertus Lec.

Very rarely prune trees in this state are injured by this beetle, which bores into the smaller branches and twigs. The axil of a bud or of a small branch is usually selected as the spot to begin operations and from there the comparatively large open burrow extends downward and inward to the center of the branch. The injury itself is insignificant, except that the branch may be so weakened that it readily breaks in a strong wind.

Very little is known regarding this insect and its habits. The adult beetle, which does the injury is one-half inch long, is nearly cylindrical and is brown in color. In California it is said to be partial to olive trees, but has also been reported as attacking the peach, apricot, almond, apple, pear and grape, and the grub or larva has been found boring in live oak, and almond trees. In this state, adult beetles in freshly made burrows in prune twigs were received at the Experiment Station in January.

Remedies.

Unless this insect becomes much more injurious than it has been no means of preventing its attacks will be necessary. Should a remedy become necessary, it is probable that a spraying with lime, sulphur and salt, or with whale oil soap, at the time the attack begins, would repel the beetles from the trees. If Paris green should also be added to either of these sprays it would probably poison any of the beetles that should attempt to eat into the twigs.

No. 6. The San Jose Scale.

Aspidiotus perniciosus Comst.

Scales in General.

There is no group of insects of greater economic importance than that which contains the peculiar creatures known as scale insects, or simply scales. There is hardly a shrub or tree that is not subject to their attacks, and often entire orchards are seriously injured by their ravages. The often minute size of the creatures and the difficulty of destroying them, together with their wonderful prolificacy, all combine to make them formidable pests of the orchardist. It is only necessary to mention the mealy bug of greenhouses, the fluted scale of California.

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the peach scale of the south-eastern United States, the New York plum scale, or the well known subject of this article to establish the truth of this statement.

The life history of scale insects is very peculiar and bears an intimate relationship to the proper remedies to be used in destroying them. The fully grown individuals are covered with a waxy excretion which may be of a white fluffy nature, or may form a dense protective scale. These scales vary in size, shape, color and markings with the different species or kinds, and give to the insect a peculiarly lifeless appearance, so much so that it is difficult, in many cases, to realize that they are covering living organisms which may be seriously reducing the vitality of the infested plant. But if some of these scales be carefully lifted from their resting places there will be found under them either soft fleshy bodies, the insects themselves, or numerous eggs. In the former case the females will usually begin to produce living young or eggs on the advent of settled warm weather, and will continue to produce them for several weeks. In the second case the eggs will all hatch nearly at the same time.

In either case the very young scales are active, six legged microscopic creatures, which at first crawl rapidly about but soon attach themselves firmly to some tender growth and feed upon the sap. When first hatched the males and females are very similar, but their future development differs greatly. The females grow rapidly, but when fully grown consist only of a fleshy body covered by a more or less dense scale. The legs, antennae and eyes have entirely disappeared, and of all the appendages of the body only the well developed mouth parts remain. The body gradually becomes distended with eggs or young and after they

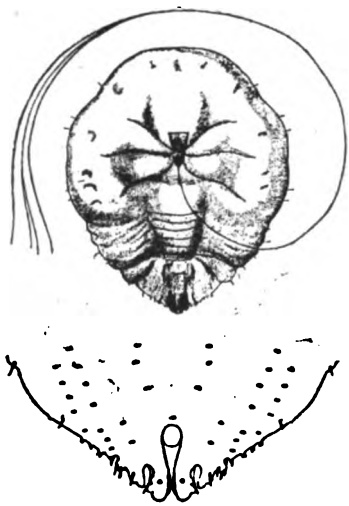


FIG. 2. *Female San Jose Scale.*

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are produced the female dies. The fully grown male instead of being motionless and without appendages, as is the female, is a minute active creature with two broad wings, long antennae, six legs, well developed eyes but no mouth parts.

Distribution of San Jose Scale.

Of all scale insects that attack our deciduous fruit and forest trees the San Jose scale is by far the worst. Dr. Howard, United States Entomologist, writes that "there is perhaps no insect capable of causing greater damage to fruit interests in the United States, or perhaps in the world, than the San Jose scale."

This pest was discovered at San Jose, California, about 1870. Where it came from is not definitely known, but at the present time it is pretty well distributed throughout the states of California, Oregon and Washington, and in British Columbia. It has also invaded Idaho on the north and Arizona and New Mexico on the south, and within the last few years has become widely distributed over the Eastern States, where it seems equally at home and equally as injurious as on the Pacific Coast. In Oregon it it is found at Ashland, Rogue River valley, Umpqua Ferry, and at several localities in the Willamette valley in the western part of the state, and at The Dalles, Walla Walla valley and Union in the eastern part. Everywhere it infests the apple, pear, peach, plum, prune, cherry, currant, rose, willow, and numerous other deciduous trees and is a serious pest of each, occuring as it does on all parts of the plant, the limbs, the leaves and the fruit. It does not attack coniferous trees nor does it breed upon rocks, as has been several times reported by observers in different parts of the state.

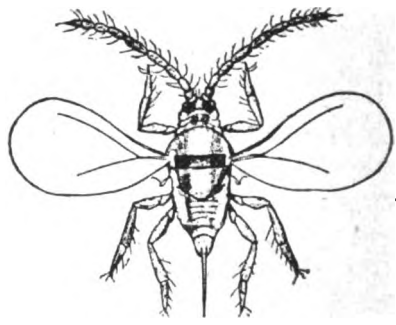


FIG. 3. *Male San Jose Scale.*

General Appearance of San Jose Scale.

The worst feature of an attack by this pest, is the fact that the insect is so small and inconspicuous that it often remains un-

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noticed, while at the same time it spreads so rapidly over the branches, leaves and fruit that it is rarely a tree can survive an unchecked attack for more than two or three years. The tree may be seen to lack vigor but often the cause of the disease is overlooked. And yet the San Jose scale is easily recognized when once seen. On badly infested plants the small, nearly circular, grey scales lie close together, even overlapping one another, and give the appearance of a grey scurfy deposit on the infested part. The natural, rich red, or brown color of the branch is obscured and appears as though covered with fine ashes. If this scurfy covering be scraped, so as to crush the insects under the scales, a yellowish oily appearance is produced. When present in comparatively small numbers on smooth bark, or on the fruit, the appearance of the scale is even more characteristic since each individual scale is surrounded by a distinct reddish discoloration. This is so conspicuous that it is of great use in enabling one to recognize, at the beginning, an attack which otherwise might remain unnoticed for some time.

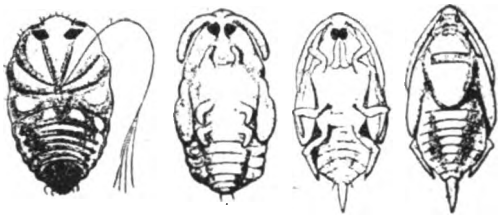


FIG. 4. *Stages of Development of Male San Jose Scale.*

Life-History.

Although the San Jose scale has been known as a fruit pest for more than twenty years, its full life-history, which has an important bearing on the subject of remedies to be used, was not worked out until three years ago. At that time Dr. Howard, aided by Mr. Pergande, demonstrated that the insect develops as follows

"The winter is passed by the nearly full-grown insects under the protection of the scale. Early in April in this latitude (Washington, D. C.) the hibernating males emerge, and by the middle of May the over-wintered females mature and begin to give birth to a new generation, continuing to produce young for a period of upward of six weeks, when they reach the limit of production of young and perish.

"The adult gives birth immediately to living young, differing in this respect from most other scale insects. Ordinarily eggs are deposited beneath the scale, which in the course of a longer or shorter time hatch, and the young larvae make their escape and migrate to different parts of the

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plant. In the case of some scale insects the female fills its scale with eggs in the fall and perishes, the eggs wintering over and hatching the following spring. In others the insect hibernates in the nearly mature condition, as does the San Jose scale, and deposits eggs in the spring or early summer. The viviparous habit, or the giving birth to living young, possessed by the San Jose scale, finds a parallel in many other insects and frequently in plant lice." * * * * *

"The newly born larva, Fig. 3, is an almost microscopic creature of pale orange yellow color, with long oval body, and with the customary six legs and two feelers The long thread-like proboscis with which the juices of the plant are sucked up is doubled on itself and lies in an invagination of the body wall, the tips only projecting.

"After crawling about for a few hours the young larva settles down and slowly works its long bristle-like sucking beak through the bark, folds its antennae and legs beneath its body and contracts to a nearly circular form. The development of the scale begins even before the larva becomes fixed. The secretion starts in the form of very minute white fibrous waxy filaments, which spring from all parts of the body and rapidly become more numerous and dense. * * * The scale is formed by the slow matting and melting together of the filaments of wax. * * *

"The male and female scales are exactly similar in size, color, and shape until after the first molt which occurs twelve days after the emergance of the larva. With this molt, however, the insects beneath the scales lose all resemblance to each other." * * *

Fig. 4. Page 114, illustrates the different stages in the development of the male which emerges as the adult shown at Fig. 3, Page 113, early in April. Fig. 2, page 112, shows the adult female.

"The length of a generation is determined by the female, and covers a period of from thirty-three to forty days. Successive generations were followed carefully throughout the summer, and it was found that at Washington four full generations are regularly developed, with the possibility of a partial fifth generation."

It was further shown that among the wintering individuals the males greatly predominate and that

"The numbers of both sexes are insignificant compared with the progeny of the later generations. The males still predominate in the second generation, but in the third and fourth generations the females considerably outnumber the males, in one instance the females from a single mother reaching the astonishing number of 464, which, with 122 males from the same parent, makes the progeny of this female 586 insects. Taking 200 females as an average of the different generations for the year, the product of a single individual from spring to fall amounts to 1,608,040,200 females. * * * The males may be estimated at the same number, giving a total of 3,216,080,400 descendants from a single insect in a single season It is not to be expected, of course, that all the individuals from a scale survive and perform their function in life, but under favorable conditions, or in the case of a tree newly infested or not heavily incrusted, the vast majority undoubtedly go through their existence without accident. Neither the rapidity with which trees become infested nor the fatal effect which so early follows the appearance of this scale insect is therefore to be wondered at.

"Owing to the long period during which the female is continually producing young, the different generations or broods in the course of the

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summer are not distinctly marked and merge insensibly into each other—so much so that at almost any time there will be found young larvae running about over the trees and scales in all stages of development. * *

* In this latitude the first young appear, as noted, by the middle of May. * * The larvae are continuously present on the trees until further hatching is prevented by severe frosts.

"In autumn, or when further development is stopped by cold weather, hibernation is begun by scales in all stages of development, from the white, minute, down-covered recently hatched young to the mature and full-grown females and males. Unquestionably many young perish during the winter, and normally in spring quite a percentage of the smaller or half-grown scales will be found to have perished. It is very probable that many females have union with the males in the fall, but the majority of them are unquestionably immature, and are fertilized in this latitude early in April by overwintered males which, as we have noted, appear nearly a month before the first young of the spring brood."

How the Scale Spreads.

Since the female scale is motionless and permanently fixed to the branch on which it feeds, it is frequently asked how it is that the scale has spread so rapidly over such a vast territory. Observation has shown that even in its active larval stage the insect is incapable by its own exertions of getting more than a few feet from the tree on which it was born. But by crawling upon birds, insects or other animals or by being wafted short distances by the wind, it is readily transported from tree to tree in the same or neighboring orchards. From one locality to another it is invariably carried upon infested fruit or nursery stock. It would therefore seem that the State Board of Horticulture, the nurserymen of the state, and everyone else should be encouraged in every way possible to continue the efforts to prevent the sale or shipment of nursery stock, except under a certificate of inspection, and to prevent the sale of infested fruit. A strict enforcement of the law would undoubtedly cause serious inconvenience and loss to a few individuals, but considered from the point of view of the growing horticultural interests of the state, it is seen to be essential.

Enemies of the San Jose Scale.

In our warfare against this insect we are aided by several minute parasitic insects and by some predaceous ones.

The most important of the latter is perhaps the twice-stabbed lady bug, *Chilocorus bivulnerus*. This is a shining black species, a little more than one-eighth of an inch long and nearly as wide, and with a bright red spot on each wing cover.

In the east the most useful of these lady-bugs is a minute

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black species known as *Pentilia misella*. It is scarcely as large as a pinhead and is shining black in color. Until recently it was supposed to be a distinctly eastern species but in 1894 it was found at Marysville, California, and in March, 1896, Mr. H. E. Dosch, Horticultural Commissioner of the first district, sent me for identification specimens he had observed feeding upon the scale at Hillsdale. I immediatly wrote Mr. Dosch as follows:

"The small beetle * * is evidently *Pentilia misella* a little coccinellid beetle which is one of the most efficient enemies of the San Jose scale in the east. * * * I would suggest that specimens be sent to each of the other commissioners to enable them to recognize the species, and that they search for it in their localities. If it should prove to be not very widely distributed in the state, undoubtedly much good could be done by introducing it in the localities in which it does not exist."

Later my identification of the species was verified by Dr. Howard.

Remedies.

The most satisfactory remedy for the San Jose scale is to thoroughly spray the trees in winter with the lime, salt and sulphur wash. Summer sprays are almost entirely useless against this particular insect. This is due to the fact that the female insect, herself protected under a scale that is practically impervious to any spray that the tree can endure when in leaf, continues to give birth to living young for a period of several weeks; and the young scales, which at first are easily destroyed, inside of two or three days secrete a covering that is also practically impervious to any washes that can be applied. Hence to eradicate the insect by summer spraying would require an application every two or three days for several weeks.

The lime, salt and sulphur wash is best prepared as follows: Slake fifty pounds of lime, then add fifty pounds of sulphur, and fifty to seventy-five gallons of water. Boil the mixture for an hour or more, or until the ingredients are practically all dissolved. Then dilute to one hundred and fifty gallons. This formula is based upon results obtained by Mr. Emile Schanno in his extensive experiments in the Fourth Horticultural District.

The best results are obtained by applying the mixture while still warm, and by applying it with considerable force in the form of a rather coarse spray. The insects multiply with such astonishing rapidity that it is essential, if one hopes to satisfactorily control them, to destroy nearly every specimen. It is therefore necessary that the spray be dashed upon the infested

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branches with such force that it will drench every part. One such thorough application of the above wash each year will prove entirely satisfactory in keeping the scale in check in the worst infested orchard.

No. 6. The Bud Moth.

Tmetocera ocellana Schrif.

I am not aware that this destructive insect has before been recorded as present in this state, although it has been present in the Eastern States for more than half a century and has come to be recognized as one of the most destructive of orchard pests as well as one of the very hardest insects to combat.

Present at Portland.

April 21st of this year, I received from Mr. J. J. Borg, of Portland, a quantity of cherry leaves that were being seriously injured by numerous small dark-colored Tortricid larvae. I at once suspected that these larvae represented the skirmish line of the bud moth, but to be certain I sent a few of them to Dr. Howard, who under date of May 7th replied that "there is little doubt that the larvae which you send are the larvae of the eye-spotted bud moth, *Tmetocera ocellana*." May 24th all doubt as to the true nature of the pest was removed by the issuing of several moths of this species.

Distribution.

This insect is of European origin and was first described more than a century ago. In this country it first attracted attention as an injurious species about 1840, the first account of its work apparently being the one published by Dr. Harris in 1841. Since then it has spread over the New England States, the Middle States, and Canada, and has been reported from Washington, D. C., Michigan and Missouri. In 1893 it was introduced at Genesee, Idaho, on nursery stock from Rochester, N. Y.,* and now it has obtained a foothold in Oregon. Whether the Portland specimens have spread from the Idaho importation or whether they have been introduced from the East on infested nursery stock I do not know.

Nature of the Injury.

The small, brown, half-grown larvae of this insect pass the winter in minute inconspicuous cocoons on the twigs and branches

*C. V. Piper, Bul. 17, Wash. Expt. Sta., p. 24.

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of infested trees. Early in spring, as soon as the buds begin to open, they leave their temporary winter quarters and attacking both fruit and leaf buds, injure many of them so seriously as to stop their growth. On large thrifty trees this injury is of but little account unless the insects are very numerous: but in young orchards or in the nursery it seriously interferes with the proper shaping of the trees. Some of the larvae bore into the buds before they have opened, but the larger proportion attack the half-opened buds and feed upon the expanding leaves and flowers, tying them together with silken threads. See Fig. 2, Plate VI. Some of the partly eaten leaves turn brown and thus render the work of the insect quite conspicuous. The tying together of the opening leaves and flowers and the brown appearance of many of them, are the most characteristic indications of the work of this pest.

Description and Life-History.

The half-grown larvae winter in inconspicuous temporary cocoons which are usually secreted about the buds, on the twigs and smaller branches. See Fig. 3, Plate VI. When the buds begin to open in spring the larvae leave their cocoons and attack both leaf and fruit buds as above described. Some of the larvae received from Mr. Borg, April 21st, were nearly or quite full grown, while others were scarcely more than one-half grown. They were dark brown in color with black head and thoracic shield, and were thinly covered with light colored hairs arising from minute black elevations. The largest ones were nearly one-half inch long.

Soon after being received they began to spin their silken cocoons within the folded mass of leaves, and on May 12th the first pupa was observed. It is shown at *a*, Fig. 1, Plate VI. May 24th the first moth appeared and by June 1st apparently all had issued.

During the daytime the moths remain quietly resting upon the trunks and larger branches of the tree, with their wings folded roof-like over the back as shown at *c*, Fig. 1, Plate VI. In this position they so closely resemble the bark in color that it is difficult to detect them. The moths probably live two or three weeks, and beginning a few days after they emerge fly about from tree to tree, mostly in the night, and deposit their eggs singly

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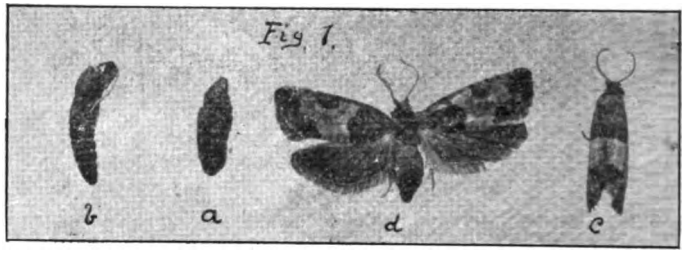








PLATE IV. THE BUD MOTH AND ITS WORK.

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or in small clusters upon the leaves. In from seven to ten days these eggs hatch. The young larva, which is at first green, at once begins to feed, usually upon the lower epidermis of the leaf. It soon spins for itself a silken tube open at both ends, and usually located beside the midrib. Fig. 4, Plate VI shows a leaf that has been partially destroyed. Throughout the summer the larvae work upon the leaves in this manner, but towards fall they retreat upon the twigs and branches and construct the temporary cocoons in which they pass the winter as before described.

Food Plants.

So far I have received only specimens that were attacking cherry leaves. It is, therefore, somewhat early to consider this insect as a prune pest, but in the Eastern States it has been known to attack the buds on apple, pear, peach, cherry, quince and plum trees, and blackberry bushes, and there can be little doubt that, since it is now present in the state, it will soon attack our prunes.

Remedies.

In the East this pest is proving an exceedingly hard one to combat. No satisfactory results have been obtained in destroying the larvae in their winter quarters, but it is possible that in this climate a winter spraying with strong kerosene emulsion, or lime, salt and sulphur wash would be effective. It is also possible to destroy a very large proportion of the larvae by spraying the trees with Paris green just before the flowers open. The opening buds should be kept coated with the poison so that the larvae may be killed before entering within their protecting cover. We are also of the opinion that a thorough under-spraying of the leaves with Paris green, between June 1st and June 10th, would prove effective. In either case one pound of the poison should be used in two hundred gallons of bordeaux mixture.

Most of our information regarding this insect has been derived from the publications of Mr. Mark Vernon Slingerland who first worked out its complete life-history.*

No. 8. The Clover Mite.

Bryobia pratensis Garman.

In this state this mite is generally known as the "red spider." The pest was first recorded as present in Oregon in 1889. Since then it has spread rapidly until now it is present in nearly all

*Bul. 50 and 107, Cornell Univ. Expt. Sta.

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the fruit-growing regions of our state, but has so far done no serious injury. During the winter of 1895–6 the extraordinary abundance of the eggs, principally on prune trees, attracted general attention throughout the state.

The eggs are shining red and are so small that when placed singly they are difficult to find. When at all abundant, however, they are deposited in masses, preferably at the base of the buds, or in other protected places on the bark, and give to such spots the appearance of being "rusty."

Our observations show that these eggs under favorable conditions begin to hatch as early as March 20th and continue to hatch for at least six weeks. By April 21st, '96, the young mites in all stages of development were present in unlimited numbers upon the leaves of various fruit trees. Even at this early date the leaves on the worst infested trees began to look pale and sickly and there was every indication that the attack was to be a serious one; but the long continued cold rains following that date were so fatal to the young mites that by June 1st only a few adults could be found.

Remedies.

Mr. C. P. Gillette, of the Colorado Experiment Station, has shown that the eggs are effectively destroyed by spraying the trees in winter with a solution of whale-oil soap, one pound to four gallons of water, or one part of kerosene emulsion diluted with four parts of water. We have also shown that the mites in all stages may be perfectly destroyed in summer by spraying the infested trees with one part of kerosene emulsion in fifteen parts of water.

No. 9. The Red Spider.

Tetranychus Sp.

This mite is probably the well known "red spider" of the greenhouse *Tetranychus telarius*. At Corvallis it is even more abundant upon prune trees than is the clover mite, but it does not seem to have attracted such general attention in other parts of the state. To the unaided eye it appears very similar to that mite and the general appearance of infested trees is the same. The clover mite, however, is rarely found in the adult stage upon the leaves, and the eggs are always deposited upon the branches or trunk, while the "red spiders" may be found in all stages upon

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the leaves,—the eggs, the young in all stages and the adults being protected under a delicate web on the undersides of the leaves.

The winter eggs, are deposited upon the trunk and branches, as are those of the clover mite and when abundant give the bark the same "rusty" appearance. The remedies for the pest are the same as those used for the clover mite.

No. 10. The Prune-Leaf Weevil.

Tricolepis inornata Horn.

The unpublished notes of Prof. F. L. Washburn, record this little grey weevil as feeding upon the leaves of prune trees at Corvallis, May 17th, 1891. May 12th of the same year, Mr. J. H. Albert, of Salem, Oregon, sent specimens of the same insect to the United States Department of Agriculture, with the report that they were "eating the foliage of young prune trees, stripping them in a short time." No other reports of injury from this insect have been received.

No. 11. Plant Lice or Aphids.

Two or more species of plant lice occur upon prunes in this state. Early in November, 1896, a small prune tree was observed on the College grounds, the leaves and twigs of which were completely covered with rather dark wingless and winged aphids which we somewhat doubtfully determined as the plum aphis, *Apis prunifoliae* Fitch. May 31st leaves of the French prune were received from Halsey, Oregon, which were badly infested with the hop louse, *Phorodon humuli*. The report accompanying them stated that the aphids were very thick on French prunes, but that the Italians had not been attacked. When received they were fast acquiring wings and, no doubt, a few days later all had migrated from the prunes to the hops.

In their early stages these plant lice are pale green in color and are found on the undersides of the leaves. They winter in the egg state on the twigs, and the young lice appear upon the leaves principally in spring and fall. When abundant they cause the leaves to become curled or twisted and discolored.

The best remedy is to under-spray the leaves with kerosene emulsion, using one part of the emulsion to 12 or 15 parts of water. The spray should be very fine and mist-like so that it will, if possible, touch every insect.

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No. 12. The Peach-Twig Moth.

Anarsia lineatella (?) Zeller.

June 9th, 1895, Mr. Hugo Garbers, of Hugo, Or., reported to this department that the twigs on his peach trees were being destroyed by a small worm boring in at the tip. A few days later, Mr. H. E. Dosch, Horticultural Commissioner for the First District, reported the same injury to prunes as very common throughout his district. Up to and including the 18th of June many similar reports were received, some of which were accompanied by injured twigs each of which contained a single larva.

These larvae were reddish-pink in color with the head and shield of the first segment pale brown, and corresponded in every particular with Mr. William Saunder's description of the larvae of *A. lineatella* as quoted by Dr. Lintner in his first report on the "Injurious and Other Insects of New York."

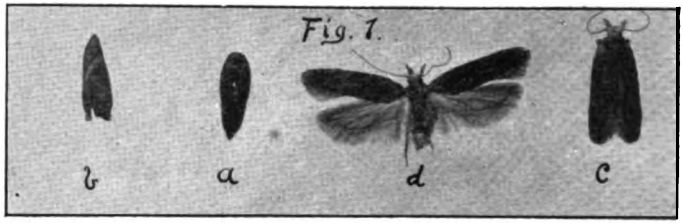
June 22d, 1896, some of these larvae were observed to have left the twigs and to have pupated in various parts of the breeding jars, the pupae being held in position by a very slight cocoon consisting only of a few silken threads. July 3d four moths issued from these pupae. These moths agreed perfectly with the description of *A. lineatella* as quoted by Dr. Lintner in the article referred to above.

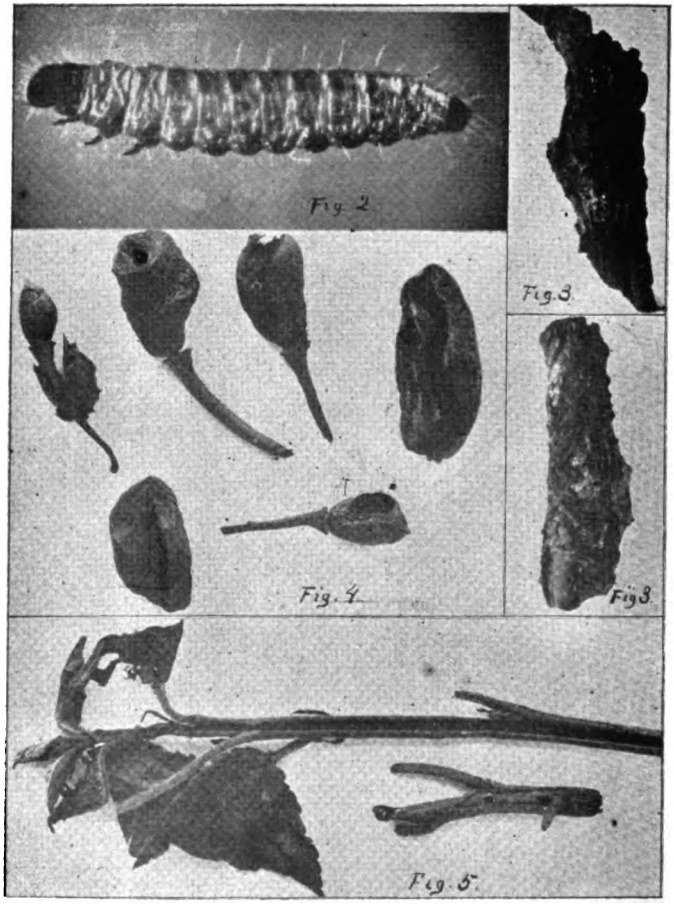
No further reports of injury to prune trees were received, and nothing more was observed concerning this insect until Oct. 2, 1896, when the strawberry plants on the College grounds, and in a neighboring patch were found to be very badly infested by reddish-pink larvae which were not to be distinguished from those that had attacked peach and prune twigs in June. Several infested plants were removed to the insectary, and together with plants out of doors, were examined from time to time throughout the winter, with the result that it was found that the larvae pass the winter in their burrows in the strawberry crowns in a nearly dormant condition. During the winter infested strawberry crowns were received from several localities and in every case the burrows were found to contain the larvae.

May 19th, 1897, one moth issued in a cage in the insectary, although an examination of plants out of doors showed that the larvae were just beginning to pupate, and it was June 1st before any considerable number of pupae could be found. At the

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THE TWIG-BORER AND ITS WORK.
PLATE VII.

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present time, June 15th, moths are still continuing to issue. These moths are exceedingly similar to, if not identical with those reared from peach and prune twigs last July.

From the fact that there was a somewhat extensive attack by the twig-borer last June, and still no evidence throughout the summer, fall, and early winter months, of any attack on prune trees by a second brood of these larvae, and since in early fall strawberry plants were so generally attacked by great numbers of apparantly identical larvae, I have been led to infer that the July brood of moths deposits its eggs almost entirely upon the strawberry, although that inference is somewhat opposed to the statement made by Professor Comstock that "the fruit-inhabiting larvae are found [in peaches] during the latter part of July and August and mature during September."* and is entirely opposed to the statement of two prominent California authorities, that the small larvae bore into the bark of infested trees and there pass the winter in the larval stage.†

April 20th, larvae of a twig-borer were received from Halsey, Or., and between that time and May 25th, when the last specimens were received, the work of this insect was reported from Halsey, Hugo, Lookingglass, Oakland, Dundee, Yoncalla, Junction, Bellefontaine and Granger and were observed at Corvallis, Liberty and Rosedale. Mr. H. E. Dosch, Horticultural Commissioner for the First District, also writes me that he has numerous letters regarding this pest from various parts, and Mr. C. L. Duley, Commissioner of the Second District, writes that the "pest is everwhere and small trees are literally denuded of terminal buds."

The first larvae received were slightly more than one-fourth inch long, and were o a dirty brown or dull greyish black color, with head, first and last segments, and true legs shining black. In general appearance they so closely resembled the larvae of the bud moth that at first I mistook them for that insect. I soon noticed, however, that the habits of the two species were entirely different and that every larva o the twig-borer was readily distinguished by its shining black terminal segment. But this character, together with the general color of the larvae, rendered

*Rept. Com. Agri. 1879, p. 255.
†Alexander Craw, Fourth Biennial Rept. Cal. Bd o Hort.
†C. W. Woodworth, Rept. Cal. Expt. Sta. 1894-5, p. 244.

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them so unlike the larvae of *Anarsia lineatella* (?) as described, and as seen in strawberry plants, and in prune twigs last June, that it did not occur to me that they could belong to that species, until May 17th when four of the moths issued. One of these moths was at once sent to Dr. C. H. Fernald who wrote that it is *Anarsia lineatella*.

If this determination is correct, and there can be no reasonable doubt of its accuracy since Dr. Fernald is without doubt the best American authority on the microlepidoptera, we are brought face to face with the peculiar phenomenon of a well known insect—one which was described in Europe nearly sixty years ago and which has been an important insect pest in this country for nearly forty years—being bred, in May, from larvae which are entirely different from those which are supposed to produce it: while on the other hand a very similar but evidently quite distinct insect is bred from apparently normal larvae of *A. lineatella* which winter in strawberry crowns, and the second brood of which occasionally attacks the twigs of peach, prune and plum trees in June. Either two species must be involved in this phenomenon or the larvae of *A. lineatella* must exhibit a *double dimorphism* due to different food plants and seasons. It appears to us very probable that hitherto two very similar but entirely distinct species have been united under the name *Anarsia lineatella*; that one of these species breeds normally in strawberry plants but may occasionally attack young shoots of the genus Prunus in June and July; while the other so far as known breeds only upon trees of the same genus, wintering in the half-grown larval condition in shallow burrows in the bark. If this supposition proves true, the interesting question arises, which of the two is *Anarsia lineatella* and what is the other species? May it not after all be the *A. pruinella* Clem, which has been discarded, as a synonym of *A. lineatella* Zeller. The proper answers to these questions are of considerable scientific and economic importance since they may have a direct bearing on the efficiency of certain remedial measures.

Description and Life-History.

The twig-borer moth is shown at *c* and *d*, Fig. 1, Plate VII, enlarged two diameters. The fore wings are dark grey, almost black in color, and are splashed with a few short black lines or

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streaks. The mounted specimens greatly resemble the moths reared from the larvae in strawberry crowns, but are slightly larger, and darker in color. The habits of the living moths are quite different. Those reared from the strawberry crowns crawl down among the vines even into crevices in the soil, apparently for the purpose of depositing eggs upon the crowns, and when disturbed run or flutter about with wings half spread. On the other hand the moths of the twig-borer invariably take an elevated position in the breeding cage, and with the fore part of the body slightly raised, and the labial palpi held rigidly upright in front of the face, they present a very characteristic and alert appearance. When disturbed they dart rapidly about, suddenly alighting again in the same characteristic attitude upon another portion of the cage. When out of doors upon the trees, it must be nearly impossible to distinguish them from buds. The moths began to appear in our breeding cage May 17th, and continued to emerge until June 5th.

The larva is shown greatly enlarged at Fig. 2, Plate VII. It is brownish black or dull dirty black in color, with head, shield, anal segment and true legs black, and is covered sparsely with light colored hairs which arise from minute elevations. When full-grown the larvae are nearly one-half inch long. They then spin a very loose silken cocoon, wherever they may be feeding, in which they pupate. The first pupa was seen May 8th, and since the first moths appeared May 17th, the pupal stage lasts about ten days. The pupa and empty pupal case are shown at *a* and *b*, Fig. 1, Plate VII.

Injury Done.

The half-grown larvae pass the winter in minute burrows in the bark of infested trees. See Fig. 3, Plate VII. In spring soon after the buds begin to open, some of the larvae leave their winter quarters and bore directly into the center of the buds in such a manner as to destroy the terminal ones. The shoot, therefore, fails to develop although often the dead terminal leaves may be surrounded by a whorl of well developed leaves. Later they attack the rapidly growing shoots, entering them either at the tip, or in the axil of a leaf, and boring in the pith as shown in Fig. V, Plate VII. As soon as the fruit begins to develop, it is also attacked, the larvae usually boring directly to the pit upon which they seem to prefer to feed. See Fig. 4, Plate VII.

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Other Generations.

During the summer we shall attempt to determine where the moths deposit their eggs, how many generations of larvae there are and how they feed. It is probable, however, that the one or more summer broods of larvae feed upon the leaves of the prune and that unless very numerous they do but little injury. As fall approaches the half-grown larvae probably retreat upon the branches, where they burrow into the bark and pass the winter, ready to emerge and attack the young shoots as soon as they begin to develop in spring.

Remedies.

It is possible that a winter spraying with strong kerosene emulsion, or lime, salt and sulphur wash would prove effective in destroying the half-grown larvae in their winter quarters; but since they must be exceedingly well protected in their burrows, we are strongly of the opinion that the best and cheapest remedy is to spray the trees just when the leaf buds are unfolding with Paris green, so that the larva's first meal in the spring will be a poisonous one. The best results will be obtained by applying the poison in bordeaux mixture, using one pound to each 200 gallons. It is also possible that a more complete knowledge of its life history will show that this insect may be successfully controlled by spraying at other times.

No. 13. The Box-Elder Plant Bug.

Leptocoris trivittatus Say.

This insect, which in a general way resembles an ordinary squash bug with fine red markings, is quite generally distributed throughout the state. Mr. Emile Shanno, Horticultural Commissioner for the Fifth District, has reported them as being exceedingly abundant in some old orchards at The Dalles, and that they seem fond of sweet plums, etc., clustering upon them in great numbers and sucking the juice.

Probably there is no better remedy than to spray them with strong kerosene emulsion or to jar them on to a sheet or blanket and quickly throw them into a tub of water to which a little kerosene oil has been added.

The cuts illustrating these articles have been prepared by Prof. E F. Pernot of the Department of Photography and Engraving. Fig. 1 is after Riley; Figs. 2, 3, and 4 are after Howard; *b*. Fig. 1, Plate V is after Marlatt; and Figs. 2, 3 and 4. Plate VI are after Slingerland. All others are original and are from material prepared by the author.

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OREGON AGRICULTURAL

Experiment Station.

BULLETIN NO. 46---JUNE, 1897.



A Plant that Poisons Cattle.

CICUTA

(*Cicuta vagans* Green.)

By U. P. HEDRICK.

The Bulletins of this Station are sent free to all residents of Oregon who request them.

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G. B. KEADY, PRINTER.
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A PLANT THAT POISONS CATTLE.

Introduction.

A PLANT growing in the low pasture lands of Oregon, poisons cattle in the late winter and early spring. Last spring probably not less than one hundred cattle were poisoned in those parts of the state where this plant grows. The inquiries as to what this plant is, has been a common and urgent one made of the Station men at the Oregon Experiment Station. Several attempts have been made to answer it. Such investigations may be briefly noted as follows:

In the summer of 1889, Professor P. H. Irish, then in charge of the Department of Chemistry of this Station, fed the following plants to stock:* Common Larkspur (*Delphinium exaltatum* Ait.), Camass (*Camassia esculenta* Lindl.), Sanicle (*Sanicula howellii* C. & R.), degenerated cultivated Parsnip (*Pastinica sativa*, L.) and Cow Parsnip (*Heracleum lanatum* Michx.); all had been reported as having poisoned cattle, but as fed by Professor Irish proved harmless.

In the spring of 1896 a farmer in Linn county sent to the Station a quantity of roots of Larkspur, saying that he felt sure that cattle of his had died from eating them. A cow at the Station was made to eat the roots sent and no ill effects followed, again proving the harmless nature of the roots of Larkspur.

The following letter, recieved January 6, 1897, from Waldport, Lincoln County, Oregon, is published as being typical of letters received every spring, and as indicating the time that reports of cattle poisoning begin to come in.

"I send by to-day's mail a root that is playing havoc among the cattle in this section of the state. A number of cattle have died in this vicinity from eating it, several having died on my ranch. What will counteract the poison that the plant contains?

Yours respectfully,
W. H. Harrison.

The roots proved to be those of *Cicuta vagans* Greene,—a

*Bul. No. 3. p. 25, Ore Expt. Sta.

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plant of the Parsnip (Umbelliferae) family. Upon request, Mr. Harrison sent a quantity of the roots to the Station. A few of these were fed experimentally to two cows, and, though but a small quantity of the roots was taken into the stomachs of the animals in both cases, death resulted within two hours. The behavior of these animals under the influence of the poison and the remedies tried, will be described in another part of the bulletin.

Following the above experiment, several plants belonging to the Parsnip family, closely related to Cicuta, and generally found growing with it, and often suspected as being poisonous, were fed and proved to be harmless. This, and a more thorough investigation of the properties of Cicuta, seem to indicate, conclusively, that the latter is the plant that poisons cattle.

Before attempting a further discussion of the plant in question, it may be said that its description for popular identification, is attended with many difficulties; for it belongs to a family, many of whose members are so nearly alike in appearance and habits that a skilled botanist can identify some species only by minute differences in plant structure. I must, therefore, in my description, enter into details that might seem unnecessary to one not apprised of the difficulties to overcome. But, by the aid of the plates, made from photographs, and the descriptions of plants that might be mistaken for Cicuta, the average reader should have but little difficulty in identifying the plant in queston.

Name.

The name, *Cicuta vagans* Greene, was given by Professor Edwin L. Greene, now of the Catholic University, Washington, D. C., in 1889.* Previously, it had been considered as identical with *Cicuta maculata* Linn, the Eastern species of this genus. In all text-books, applicable to the Pacific Coast, the plant is yet called *C. maculata*, but botanists have adopted the name given by Greene.

In the matter of common names there is much confusion regarding this, as of many plants in the Parsnip family. The Cicutas are known in the various localities in which they are found by a number of common names. Gray, our best authority, alone, gives five popular names to the common Cicuta, as

*Pittonia, Vol II, Part 7, Dec. 1889.

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follows: Water Hemlock, Musquash Root, Spotted Cow bane, Beaver Poison and Muskrat Weed. Other botanists add to these, Wild Parsnip, Water Parsnip, Cow bane, and Snake Root. All these show how inaccurate and unsatisfactory are common names. If any one of these popular names is to be used, Water Hemlock is most applicable, but there cannot be any reasonable objection to calling the plant Cicuta, a name, about which, there could be no confusion.

Description.

The Cicuta found in Oregon, is a tall, smooth, coarse growing plant; its stems are round and hollow, branch from the base, may be erect or reclining in growth, and reach a height of from 3 to 6 feet; the stems spring from a bulb-like, perennial root and after flowering in mid-summer soon die down; the leaves are from 2 to 3 feet long, smooth and glaucous, sometimes with a purplish cast, two or three times divided (bi or tri-pinnate); the leaflets are borne on the upper third of the leaf, there being, generally from 4 to 6 pairs, they are oblong and lance-shaped, about 2 inches in length, ¾ of an inch wide, coarsely toothed, sometimes unequally divided or lobed, and with small veins running from the midrib to the notches in the edge of the leaflet. A part of an old and of a young leaf are shown in Plate I.

The plant blooms in midsummer and bears an umbel or umbrella shaped cluster of small, white flowers at the end of a long stalk or peduncle (Plate I); from the blossoms, broadly ovate, kidney-shaped, ribbed fruits about ⅛ of an inch long are formed; these, when cut crosswise, show minute tubes containing an aromatic oil much like that in the seeds of the common Parsnip; the seeds in these fruits are small, nearly cylindrical in shape, and have a slightly hollowed face.

In studying the plant it will be found that the *root bulb is he most distinctive part and will aid most in identification*. Special attention is called to Plate II in which the bulbs are well illustrated. A comparison of this plate with the other plates shows very strikingly the difference between the underground parts of plants of the Parsnip family, and makes obvious the great value of the roots as a means of identifying Cicuta. Taking the bulbous roots alone, as a means of identification, one could hardly make a mistake in naming Cicuta. The subterranean

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part of Cicuta, properly speaking, is a close jointed, underground stem. It is bulb like in appearance, 2 to 4 inches long and 1 to 2 inches thick. In color the exterior is a dark purplish green, the interior a yellowish white, the flesh firm and bearing an abundance of reddish, aromatic oil—the odor of Parsnip being most decided; the root bulb is only partly underground and emits long fibrous roots from beneath. The poisonous property of the plant, cicutoxine, is found in the oil of the bulb.

Habits.

The flowering and fruiting part of Cicuta is sustained by food stored away during one or more years of immature existence. The reservoir for this supply is the bulb-like underground stem. After flowering, plant and root die, but while the flower is developing, the crown of the root, or underground stem, sends out one or more large buds, which, before the flowering stalk is dead, have formed roots of their own and are ready to produce a new plant. These buds sometimes require one, and sometimes two seasons for full growth. From the above it will be seen that the life limit of the species is intermediate between that of a biennial and a perennial.

In growth, as the plant reaches maturity, it becomes stout and scraggly, very often covering an area of five or six feet. Before reaching the fruiting season, the underground stem and roots become exhausted and begin to decay, the plant at this time being sustained and supported by tough, fibrous roots springing from a point where the leaves break from the underground stem. These roots are called accessory roots. At this period the young offsets are being formed.

Distribution.

Cicuta is found, in Oregon, in marshy or wet places both on the seashore and in the mountains. It is of most frequent occurrence along the banks of coast rivers and inlets, but is reported as being quite common about the lakes of Southern and South-Eastern Oregon. It is so plentiful throughout all of Western Oregon, that it is dangerous to cattle, during the spring, in uncultivated, marshy, pasture land. Cicuta is also found in abundance in Northern California, in Washington, and in British Columbia.

Other semi-aquatic plants of the Parsnip family, are often

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found growing with the Cicuta, which adds to the difficulty of recognizing it and gives the others, most of which are harmless, a bad reputation. It is safe to say that no other plant in this family need be feared in Oregon pastures at the time when Cicuta is dangerous, viz. from January to May.

Damage Done by Cicuta.

It is hard to estimate the number of cattle killed yearly in Oregon by eating Cicuta. One hundred would be a low estimate in my judgment. Animals eat the underground portion of Cicuta in getting the tops which form about the first green herbage in early spring; as they browse the foliage, the roots, being only partly subterranean, and growing in a soft soil, are pulled up and eaten. A piece the size of a walnut, it was found by experiment, is sufficient to kill a cow. It is probable that the poisonous constituent is found only in the underground stem and the roots.

While the victims of the plant are chiefly cattle, yet they are not exclusively so. The poisonous parts are often mistaken for Parsnips, Artichokes and Horse-radish, and thus human victims are not infrequent. A number of cases of poisoning from Cicuta are annually reported in the United States. A writer in a local paper a few months ago, reported the case of two cattlemen in Southern Oregon, who, after eating "Wild Parsnip," presumably Cicuta, died in a few hours. Falk reports, that in Europe, in thirty-one cases of poisoning from Cicuta, 45 per cent died.

Symptoms of Poisoning, and Remedies.

Soon after receiving a quantity of the Cicuta bulbs from Mr. Harrison of Waldport, as before mentioned, it was decided to try their effects upon a cow, in order that a more direct knowledge of the action of the poison might be obtained. The following is the description of the behavior of two animals to which was fed the Cicuta,—the notes having been taken by Professor H. T. French, the Station Agriculturist.

"A bulb was cut into small pieces, mixed with a carrot cut up in the same way, and fed to a two-year old grade heifer. The material was fed at 8 o'clock, a. m., and at 9:30 the animal was dead. The poison performed its work so quickly, that we were unable to be present at the moment death occurred. The animal

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evidently died in a spasm, froth and foam having escaped from its mouth in considerable quantities.

"On post-mortem examination, pieces of the root were found in the rumen, and in the reticulum or second stomach. None was found beyond the second stomach. It was somewhat surprising to find not more than two drams of the root in the stomach. A very small portion might have passed beyond recognition by mastication, but a careful examination was made resulting in the finding of the above amount. From the amount left in the feed-box it was evident that only a very small portion had been eaten.

"The lungs were highly congested, otherwise there were no abnormal conditions noticed in the abdominal or thoracic cavities.

"The following day another animal was fed the poisonous roots in order that an attempt might be made to counteract the effect of the poison with an antidote.

"A calf one year old was selected for the experiment. The temperature of the animal was taken in the evening and morning preceding the experiment. The normal was found to be 102½ degrees.

"Two bulbs the size of an egg were cut and mixed with carrots, and a little grain sprinkled over the roots. The material was eaten under protest in order to get the grain and carrots.

"The roots were fed at 9:15, a. m.; at 9:40 the temperature was 103, and the muscles about the nose began to twitch. At 10 o'clock the temperature had risen to 103½, and the animal was a little uneasy. At 10:25 the temperature was 104, and there was a trembling about the flanks. The eyes watered very freely; at 10:35 the animal was somewhat excited, and the temperature was 104¼. At this time urination began and continued very freely until death ensued. At 10:45 the animal fell over on its side in a spasm. The eyes were drawn and the muscles were rigid and contracted violently. The animal fell backward rather than sideways, and when part way down rolled on its side.

"As soon as possible it was given an ounce of spirits of turpentine in a quart of milk, and immediately the calf recovered its feet and began to walk about, though with difficulty; its limbs were stiff and it walked with a straddling gait. At

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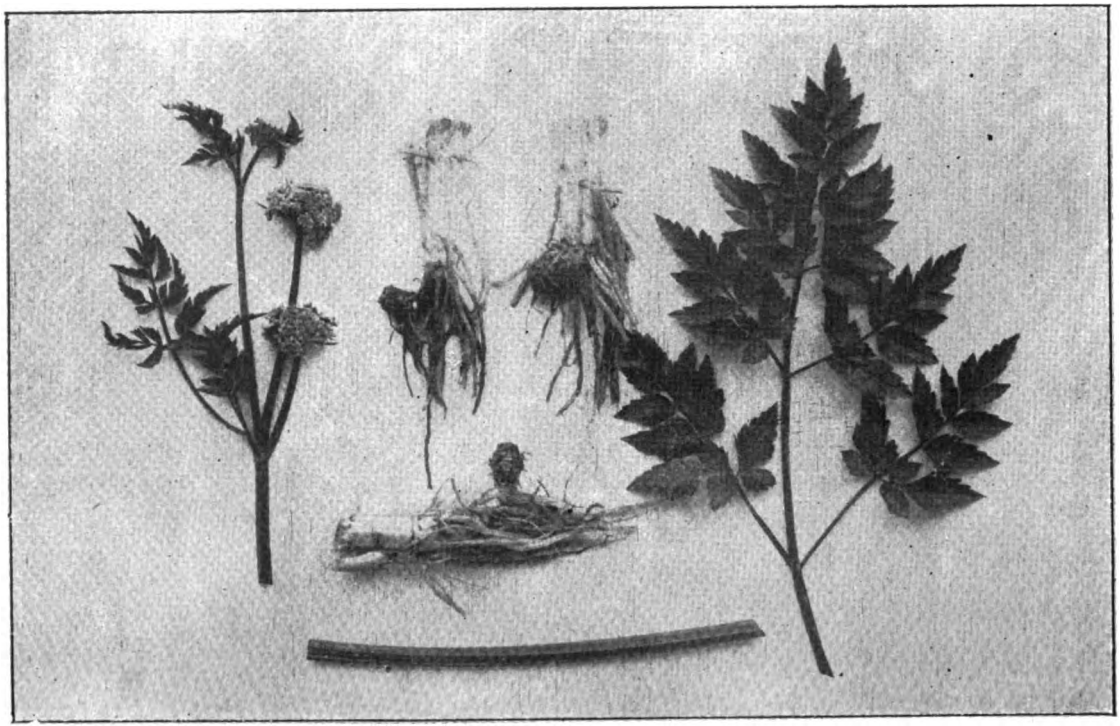


PLATE III. WILD CELERY. *Oenanthe sarmentosa* Nutt.

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10:55 the temperature stood at 104¼ and perspiration was flowing very freely. The respirations were hurried being about double the usual number per minute; soon there were indications of severe spasms. The dose of turpentine and milk was repeated and the animal stood up till 11:30, when it went down as before. A full dose of tincture of aconite with a quart of milk was given, but no results were noticed; immediately after a hypodermic injection of nitro-glycerin was made, but with no results. The spasms were almost continuous from the time the animal fell over until death took place at 11:45, just two and one-half hours from the time the poison was administered. The highest temperature reached was 106¼ degrees."

The cattle were fed, as above described, in March. During the next few weeks a number of "sure" remedies were recommended. The most common of these are lard, bacon grease, milk, and flour. The milk had proved to be worthless in the first experiments, but to satisfy ourselves regarding the other named remedies, and to try some of a more medicinal nature, another animal, early in May, was fed several of the poisonous bulbs. The bulbs were of the same lot used in the first experiments, but had been growing for a month in a green house. It was expected that growth would remove some of the dangerous properties of the bulbs, but it was a surprise to find that an animal eating many times as much of them as had killed the cows in the previous experiment suffered no ill effects whatever. The conclusion is obvious; the bulbs are only dangerously poison when in the dormant state, or for a short time after growth begins in the spring. Cattle are likely, then, to be poisoned only from the first of January to the middle of May.

It is probable that the simple remedies, as lard, bacon grease, flour, and milk, so highly recommended by stockmen, in the milder cases, are of value, as they are substances which would tend to retard the absorption of the poison in the stomach, and, given in sufficient quantities, would act as a purgative to expel it from the intestines. But it is my opinon that none of these would be of avail with an animal that had swallowed even a small quantity, a few drams, of the bulb when the poison is most virulent. Further investigation may develop some agent more potent as a remedy but until then, farmers must depend upon

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prevention—keeping their cattle from pasture lands containing Cicuta.

Eradication.

An effort should be make to eradicate Cicuta completely from all enclosed pastures. Cultivation will soon exterminate it from fields that can be tilled. In other pasture lands, the plant once recognized, can be eradicated during spring and summer by going over the field with a sharp hoe, spade, or shovel, and chopping out the roots, a thing easily done; or, better still, while the ground is soft in the early spring, just after the plants begin to grow, they may be pulled out by hand thus securing complete extirpation. In most pastures Cicuta occurs but sparingly and to detect it will require close observation. The bulbs can be readily destroyed by exposing them to the direct action of the elements—sun, frost, and wind, so that an occasional plowing is effective in getting rid of the plant.

Related Plants Likely to be Mistaken for Cicuta.

Two plants closely related to Cicuta are often mistaken for it, and, since both are more plentiful than the Cicuta, cause those upon whose premises they grow, much uneasiness. A careful comparison of the description of the plants here given aided by the plates, will enable farmers to easily distinguish these more common and harmless plants from the Cicuta. The first of these plants is :—

WILD CELERY. (*Oenanthe sarmentosa* Nutt.)—Wild Celery is well shown in Plate III. A comparison of the parts of the plant in the plate with those of Cicuta on Plates I and II, shows that the leaves and leaflets are much smaller, the stems weaker and *ridged*, that there are bracts or leaflets, called involucres, under the flowers ; *and that the root stocks or bulbs, are very much different, in being smaller, less closely attached to the plant, and of a different shape.* The plant is more aquatic in habit than the Cicuta; growing nearly always in water, often in running water Wild Celery is smaller than the Cicuta, growing only from 2 to 3 feet high. Its thick, aromatic roots have the smell of Celery, instead of the Parsnip as has Cicuta, and the base of the leaf stems much resemble those of small Celery stems. The plant is edible and is much relished by the Indians, and is not unacceptable to a hungry White Man.

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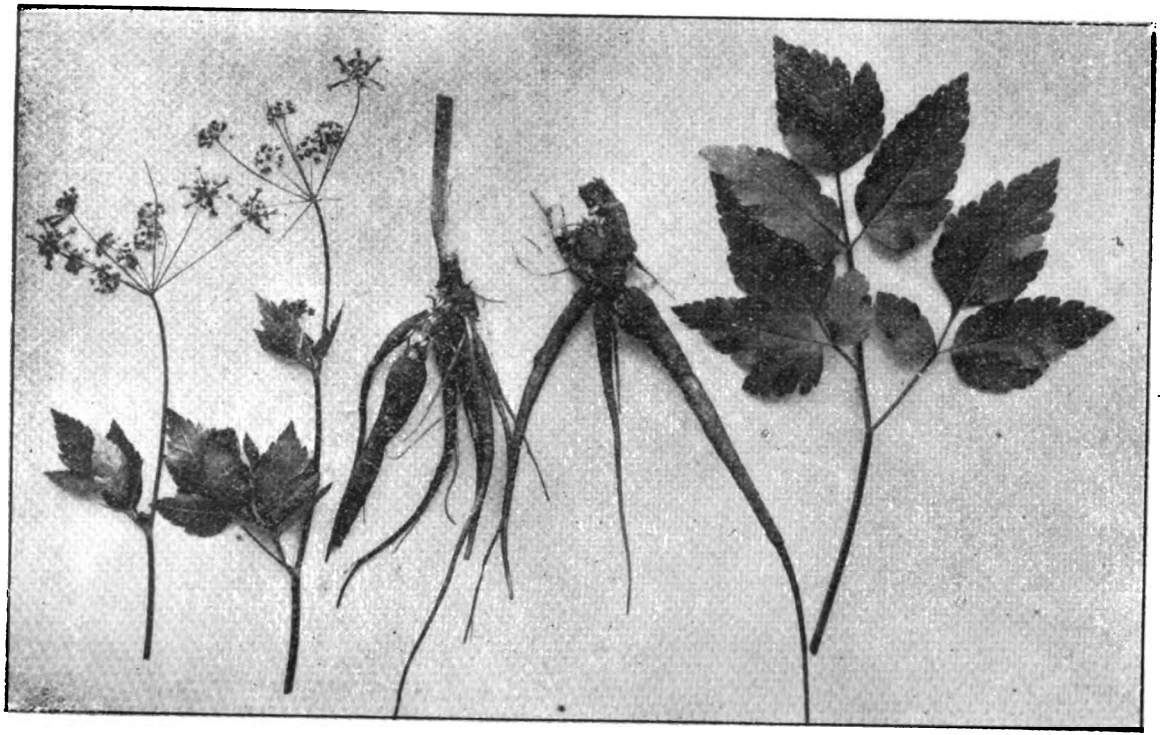


PLATE IV. SWEET CICELY. *Glycosma ambiguum* Gray.

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SWEET CICELY. (*Glycosma ambiguum* Gray.)—Sweet Cicely, the second plant that farmers commonly mistake for Cicuta, is shown in Plate IV, and a comparison of this plate with the preceding ones will make plain the differences. It may be easily distinguished from Cicuta by the root, its smaller size, its smell of Cicely or Anise instead of Parsnip, and the fact that it is common in dry lands as well as in marsh lands. Sweet Cicely is harmless.

There are other plants which as closely resemble the Cicuta as the two described above, but they are not common in pastures and are not to my knowledge suspected of being poisonous. Wild Celery and Sweet Cicely have been frequently brought to the Station as "the plants that poison cattle."

POISON HEMLOCK. (*Conium maculatum* Linn) has been sparingly introduced in waste places in the neighborhood of the older settlements, but it is not dangerous in pastures as its herbage comes at a time when good pasturage is plentiful and, moreover, its leaves exhale a sickly, disagreeable odor which repels all animals. Its smaller size, white fusiform root, foliage spotted with purple, and later appearance, easily distinguish it from Cicuta.

REVIEW.

1. Cicuta, a plant of the Parsnip family, growing in the low, pasture lands of Oregon, in late winter and early spring, poisons catttle.

2. The following plants, reported poisonous, were fed to cattle without ill effects: Larkspur, Camass, Sanicle, degenerated cultivated Parsnip, and Cow Parsnip.

3. Common names are inaccurate, and the plant in question should be called Cicuta, to avoid confusion. Locally, Cicuta is often known as, Wild Parsnip, Water Hemlock, Musquash Root, Cow Bane, Water Parsnip, Muskrat Weed, and Snake Root.

4. Cicuta is a tall, smooth, coarse, marsh perennial; the stems come from a bulb-like, underground stem; the leaves are from 2 to 3 feet long and have from 4 to 6 pairs of lance-shaped, coarsely-toothed leaflets; the plant blooms in midsummer and bears an umbel of white flowers which form small kidney-shaped,

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ribbed, aromatic fruits. *The underground root-stock is the most distinctive part of the plant and will aid most in identification.*

5 Cicuta is found throughout Oregon, Washington, Northern California, and British Columbia. It is of most frequent occurrence along banks of coast rivers and inlets.

6. It is estimated that about 100 cattle are killed annually in Oregon by eating Cicuta. Human victims of Cicuta are not infrequent in the United States.

7. After eating the Cicuta roots death takes place, commonly, in a few hours. The symptoms of poisoning are uneasiness, twitching about nose and mouth, trembling of the flanks, watery eyes, much perspiration, high temperature, continued urination, and finally violent spasms which end in death.

8. As a remedy, stockmen recommend, lard, bacon grease, milk, and flour; these, by absorbing the poison, and acting as a purgative may be of avail in mild cases.

9. Cicuta should be eradicated from enclosed pastures by cultivation, cutting out, or pulling up.

10. Two common plants of the same family, Wild Celery and Sweet Cicely, are often mistaken for Cicuta.

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BULLETIN NO. 47. SEPTEMBER, 1897.

OREGON AGRICULTURAL EXPERIMENT STATION.

CHEMICAL-AGRICULTURAL DEPARTMENTS.

THE RELATIVE DIGESTIBILITY

OF

CHEAT AND CLOVER.

BY

G W. SHAW, Chemist, and H. T. FRENCH, Agriculturist.

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RELATIVE DIGESTIBILITY OF CHEAT AND CLOVER HAY.

Much controversy has arisen over the comparative value of Cheat hay. Cheat has long been considered a valuable hay-producing plant throughout the Willamette valley. That it grows well there is little doubt. Many farmers report a yield of three to four tons per acre, and even greater yields are often mentioned. The average yield is about 2½ tons per acre. This portion of the State seems to be the natural habitat for several wild species of *Bromus;* and owing to the certainty with which Cheat may be grown, and the uncertainty which attends the efforts of the farmer in growing other varieties of grasses, it is not strange that Cheat should be retained so tenaciously.

Cheat is a very hardy plant, easily withstanding such vicissitudes of climate as are likely to prevail throughout a large portion of Western Oregon. On low, flat, heavy soil, where water is too abundant during the winter months for other grasses to thrive, Cheat will make a very good growth. It would not be easy to find a grass that can surpass Cheat under these conditions. On the higher portions of the land, or on land which is fairly well drained, there are other varieties of grasses and clovers which may be grown suscessfully, and which will give much better results when fed to stock.

The question upon which this report is intended to throw more light is not a question of *growing* Cheat, but rather its value as compared with Clover, when fed to cattle.

It is a common practice at present to feed Cheat to dairy cows as well as to all other kinds of stock; and it is with a view of discouraging its growth for dairy stock especially that these facts are presented.

The question of profit is determined more largely if possible, in dairying, than in any other branch of farming, by a proper knowledge of the food supply. It is not a question of quantity altogether, but of quality, and a proper combination of food constituents to produce the best results. The dairy cow is a delicately wrought machine which must not be over worked in consuming a large amount of material that is not needed, in order to get a sufficient supply of that which is essential in the production of milk.

When Cheat is fed to dairy cows the creamery man complains of a lack of milk supply, and this fact implies that the farmer is simply *keeping* his cows without getting proper returns from them. Much is said in these days regarding the yield of butter fat as an indicator of the value of a cow in the dairy; but it is not altogether just to the cow to apply the test before we have learned how to feed her properly. While the food, under normal conditions, will not materially change the per cent. of butter fat in milk, it will materially change the total yield by increasing the flow of milk.

It would not be right to discourage the growth of Cheat unless there is something better with which to replace it. Over a large portion of the

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Willamette valley, where Cheat is now grown, Clover can be grown successfully. This has been thoroughly demonstrated on the Experiment Station farm, and we have seen the same results obtained on other farms in this portion of the State.

The two factors entering into the value of a foodstuff are its composition and its digestibility. The first factor is determined by chemical analysis alone. The second is determined either by actual trials with animals, or with artifical digestion fluids made to correspond closely with the digestive fluids of the body. The digestible matter for most of the common cattle foods has been determined by feeding animals for a stated period upon food whose composition has been previously determined by analysis. The material so used is weighed and the excreta of the animal carefully collected, weighed and analyzed.

The solid excretum is simply that material which has escaped the action of the digestive fluids, or the indigestible matter. From its analysis, and that of the food eaten, can be calculated the amount of the food digested.

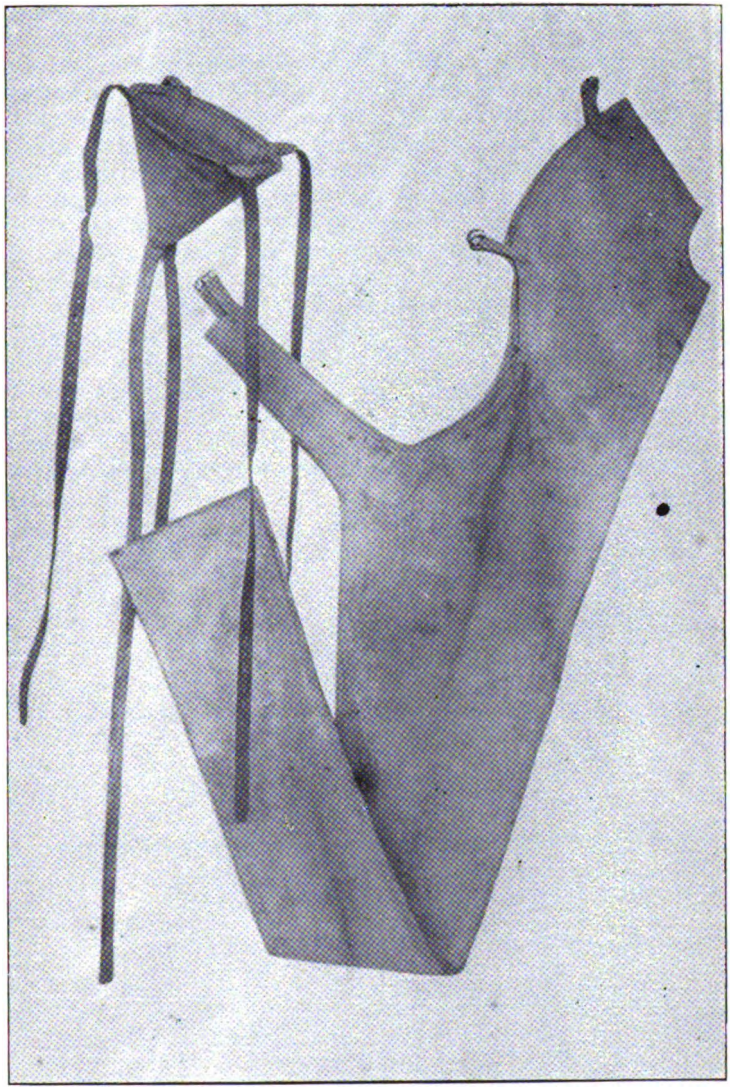
The per cents of the various nutrients that can be digested by an animal are called the *digestion co-efficients.*

Thus it is seen that chemical analysis is the first and last step in rendering intelligible the results of feeding experiments. It is absolutely essential to a proper understanding of the material used in rations, if we desire to feed economically. It is the foundation upon which the whole system of rational feeding rests. The object of the following experiment; from the chemical standpoint, was to determine the digestion co-efficients of Cheat (*Bromus secalinus*) hay, and to compare its digestibility with that of Red Clover (*Trifolium pratense*) when fed to the same animal.

It seemed the more essential to set forth the results thus contrasted since after the publication of Bulletin 39 numerous persons—some evidently not having read the bulletin—made extravagant statements as to what the author claimed. Now the fact is that the writer never did assert that the hay in question was "worthless," for such a statement would be far from the truth. What he *did intentionally* imply was that Cheat did not favorably compare with several other grasses there named, either from the standpoint of a food or in economy of production. Cheat, and even straw, can be made the basis of a ration, but it is certainly poor economy to feed a hay of low food value when there are others much better which can be had; and it is still more wasteful, as well as crude and unscientific, to feed either this or any other coarse food alone, when the advantages to be gained by properly balanced rations are so clearly set forth in the literature of the day, and are so well recognized by the most eminent feeders of the country.

The details of the feeding were as follows: A three year old Short Horn grade steer was selected for the experiment. The animal was placed in a stall arranged in such a manner that the excreta could be collected without loss. The apparatus used was that recommended by Professor Armsby, of Pennsylvania. It is shown in the accompanying illustration. The apparatus was found well adapted to the work. The preliminary feeding began on February 17, 1896, and continued till March 2d, during which time

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the animal was fed in the same manner as during the actual digestion period. During the last four days of this time the harness was adjusted to the steer, and the conditions made identical with those of the digestion period.

The hay was cut as for ordinary feeding, and after being thoroughly mixed, was weighed into rations, and a sample of each placed in an air tight bottle and brought to the laboratory for analysis. The first of the prepared rations was fed to the steer on March 2d, at 5 p. m., and the experiment ended at 5 p. m., March 8th. The water, as well as the food, given to the animal was carefully weighed. The amounts of each consumed, together with the weight of excreta, and the weight of the animal are given in Tables I and II. It is somewhat interesting to note the fact that the animal voided 58 per cent more urine during the Clover experiment than when fed on the Cheat. During the same time he drank 20 per cent. more water. The samples of dung were brought to the laboratory where they were reduced to an air-dried condition, and after being ground till the entire material would pass through a one-millimeter sieve, were preserved in air-tight bottles till analyzed.

TABLE I—CHEAT.

Dates.	*Food eaten.*	*Water drunk.*	*Weight of urine*	*Weight of solid excreta.*	*Weight of animal.*
	Pounds	Pounds	Pounds	Pounds	Pounds
March 3	16	37	11¾	29½	1006
March 4	16	40½	7	35	1012
March 5	16	28¾	3¼	30¾	1002
March 6	16	44	8	34	1007
March 7	16	32½	8¾	37¼	1008
March 8	16	33	9	32½	1006
Total	96	215¼	47¾	199½	.....

TABLE II—CLOVER.

Dates.	*Food eaten.*	*Water drunk.*	*Weight of urine*	*Weight of solid excreta.*	*Weight of animal.*
	Pounds	Pounds	Pounds	Pounds	Pounds
March 23	15	21	19	30	988
March 24	15	70	22¾	28	993
March 25	15	40	18½	33½	991
March 26	15	49½	16	36	992
March 27	15	42½	18½	32	991
March 28	15	47	18½	31	992
Total	90	270	113¼	190½	.....

The composition of the two hays was as follows:

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TABLE III.

Material.	*Clover.*		*Cheat.*	
Water	4.27	Dry matter.	7.00	Dry matter.
Dry matter	95.73		93.00	
Ether Extract	3.35	3.50	1.95	2.09
Protein	14.84	15.50	6.06	6.52
Crude Fibre	28.83	30.11	31.80	34.19
Nitrogen-free Extract	40.20	41.12	44.10	47.43
Ash	8.50	8.77	9.09	9.77
Total dry matter	95.73	100.00	93.00	100.00

For a full description of the terms above employed the reader is referred to Bulletin 39, but for the sake of reference the following resume is here inserted:

Protein, albumenoids, and nitrogenous matter mean the same thing, and are represented by the white of an egg, lean meat and the gummy part of wheat. Other things being equal, that food has the highest food value which is the richest in digestible protein. The function of this class of bodies is that of muscle forming. The term *Ether Extract* in the case of grains might well be expressed by the word fat, which is frequently used, but in the case of grasses and other coarse foods there is also included coloring matter and certain gums. *Crude fibre* is a term used to express the more woody parts of the plant, and is well represented by paper and cotton fibre. It is closely allied to starch, and with the next group belongs to the class of carbohydrates. The *Nitrogen-free Extract* is best represented by such bodies as sugar and starch, which together with the Ether Extract and Fibre serve to form animal fat and heat.

As stated above the indigestible matter constitutes the dung. This was collected during the period of the experiment, weighed and analyzed.

TABLE IV—THE STEER VOIDED AS DUNG.

	Dry Matter.
Of the clover hay, 190.5 lbs.	32.37 lbs.
Of the cheat hay, 199.7 lbs.	49.10 lbs.

The *water-free dung* showed the following composition:*

TABLE V.

	Clover.	*Cheat.*
Ether Extract	4.51	2.56
Protein	15.40	6.89
Crude Fibre	33.32	33.24
Nitrogen-free Extract	32.24	13.47
Ash	14.53	43.84
Total	100.00	100.00

* The nitrogen was corrected for metabolic nitrogen according to the method suggested by Dr. Jordan in Annual Report of Maine Station, 1888.

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From the above figures, computing the ingredients of the dung excreted during the experiment, we have:

TABLE VI.

	Clover.	*Cheat.*
Ether Extract	1.46	1.26
Protein	4.98	3.38
Crude fibre	1 .78	16.22
Nitrogen-free Extract	10.52	21.58
Ash	4.70	6.66
Total	32.37	49 10

These figures represent the indigestible matter. It is evident, then, that if these be subtracted from the figures representing the ingredients eaten, we shall obtain the amounts digested.

TABLE VII—SHOWING DIGESTIBILITY OF CLOVER HAY.

Material.	*Dry Matter.*	*Ether Extract.*	*Protein.*	*Crude Fibre.*	*Nitrogen-free Extract.*	*Ash.*
In 90 lbs. clover hay	86.15	3.02	13.35	25.94	36.29	7.55
In 190.5 lbs. clover dung	32.37	1.46	4.98	10.78	10.52	4.70
Amounts digested, lbs.	53.78	1.56	8.37	15.16	25.77	2.85

TABLE VIII—SHOWING DIGESTIBILITY OF CHEAT HAY.

Material.	*Dry Matter.*	*Ether Extract*	*Protein.*	*Crude Fibre.*	*Nitrogen-free Extract.*	*Ash.*
In 96 lbs. cheat hay	89.28	1.86	5 81	30.52	42.37	8.72
In 199.7 lbs. cheat dung	49.10	1.27	3.38	16.22	21 58	6.66
Amounts digested, lbs.	40.18	60	2.43	14.30	20.72	2.06

The following table shows the comparative digestibility of the constituents in each food stuff used in the experiment:

TABLE IX—DIGESTION CO-EFFICIENTS.

	Clover.	*Cheat.*
Dry Matter	62	45
Ether Extract	55	32
Protein	63	42
Crude Fibre	59	46
Nitrogen-free Extract	71	49
Ash	37	23

Computing the nutritive ratio* for each, as determined by the experiment, it is is found to be:

For clover hay 1: 5.3
For cheat hay 1:15.0

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The chemical analysis shows that Cheat contains a larger per cent. of indigestible woody fiber than Clover, and less than half as much protein or flesh formers. In carbohydrates, or those substances which go largely to keep up animal heat, the Cheat is better provided than the Clover. This to a certain extent explains why the Cheat gives such favorable results in keeping stock animals, or those which are being kept over winter. In the fat contained the Cheat is not nearly as well provided as the Clover.

The nutritive ratio is rather wide—that is there is a large proportion of carbohydrates to the protein, or flesh forming substances—there being 15 of the former to one of the latter. It is not economical to require the animal functions to take care of so much crude fiber in order to obtain a sufficient supply of nitrogenous material. It is cheaper to supply the deficiency by a better balanced ration. This might be done by feeding liberally with bran oil meal, pea meal, or cotton seed meal, but in feeding these concentrated foods the expense is materially increased. The best results will be obtained when we feed in the coarse food as nearly a complete, or balanced, ration as possible.

*Found by multiplying the Ether Extract by 2½, adding to the product the Crude Fibre and Nitrogen-free Extract, and dividing by the Protein. It expresses the relation between the carbohydrates and the protein.

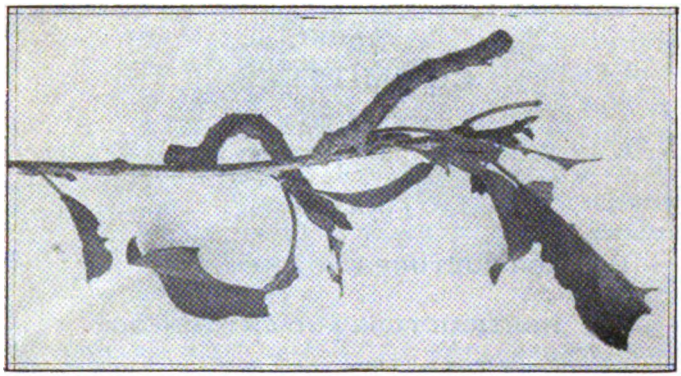
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Bulletin No. 48. January, 1898.

OREGON AGRICULTURAL

Experiment Station



SPRAYING.

The Bulletins of this Station are sent Free to all Residents of Oregon who request them.

AGRICULTURAL COLLEGE PRINTING OFFICE.
G. B. KEADY, PRINTER.
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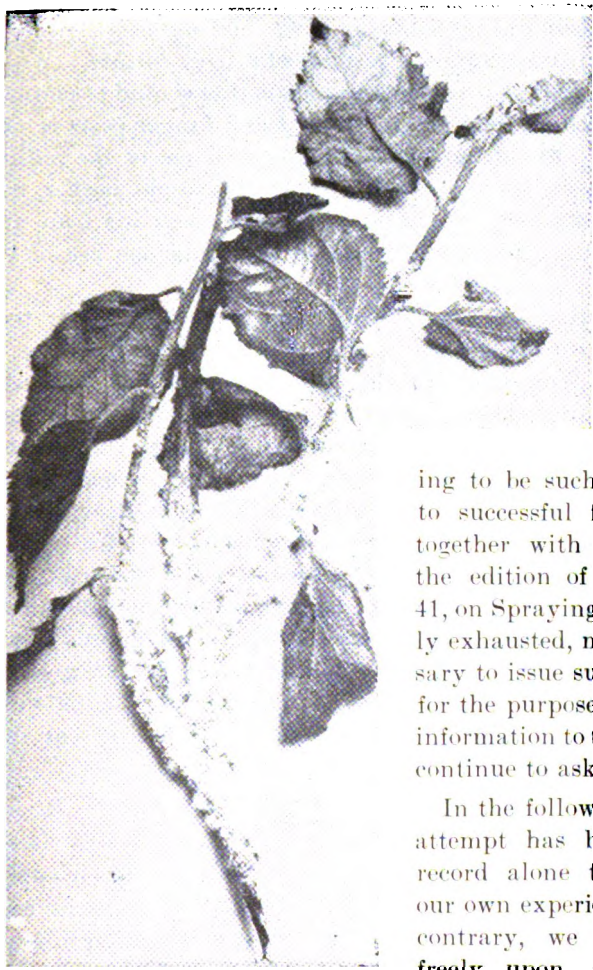
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SPRAYING.

Previous bulletins of this Station, the horticultural and agricultural press, and the publications of the State Board of Horticulture, have so widely disseminated information regarding spraying operations that another bulletin on the subject may seem almost superfluous. But the fact that spraying is coming to be such an essential to successful fruit culture, together with the fact that the edition of Bulletin No. 41, on Spraying, is completely exhausted, makes it necessary to issue such a bulletin for the purpose of supplying information to those who still continue to ask for it.



In the following pages no attempt has been made to record alone the results of our own experience. On the contrary, we have drawn freely upon all available sources—the horticultural press, the bulletins of other stations, the publications of the United States Department of Agriculture,

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and the experience of local fruit growers, as well as our own experience, but have endeavored to select and to recommend only those thoughts and operations which our experience and observations during the past two years have convinced us are most valuable under the conditions prevailing in this State.

IMPORTANCE OF SPRAYING.

We do not believe that spraying is the one essential—or even the most essential—requisite to successful fruit culture. We do not even believe that it is the only means that should be employed to hold in check the numerous insect and fungus pests of cultivated crops. But we do believe that in this age of the codling moth and apple scab, of woolly aphis and apple canker, San Jose scale and brown rot, he is wise who *insures* his fruit and trees against the ravages of these pests by a judicious use of the spray pump.

We believe that everyone who owns an apple tree, a pear tree, a cherry tree, a fruit tree of any kind, should spray that tree or cut it down. We believe this because observation has convinced us that there are indeed few fruit trees that are not infested with some form of insect pest or fungus disease, and every infested tree that remains standing and neglected is a constant menace to the many valuable orchards of the State. This obligation should rest not alone upon those who are in the business of fruit growing. It should apply as well to the farmer who grows fruit only for family use, and to the dweller in town or city who grows only a few trees in the back yard or on a vacant lot. It should apply with particular force to the two last classes. The progressive horticulturist knows that the health, even the life of his trees, the quality of his fruit, and hence the degree of his success, oftimes depends on a right use of the spray pump.

WHY WE SHOULD SPRAY.

Knowing that he had dealt extensively in Rogue River apples the past season, I wrote Hon. H. B. Miller of Eugene for an estimate of the loss sustained by the fruit growers of Oregon through the ravages of fruit pests. No better argument in favor of a widespread use of the spray pump can be advanced than his reply which is as follows:

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"In the district where we packed nearly forty carloads of apples the *pack did not average over fifty per cent. of the fruit picked.* This was in Jackson and Josephine counties.

"The greatest damage was caused by the codling moth, but I also found a few orchards that had been great producers almost ruined by CANKER, and many other valuable orchards almost ruined by San Jose scale. The entire crop of several orchards, with a thousand bushels each of otherwise fine apples, was worthless because of scale. It is quite safe to say that in the Rogue River country alone the loss of fruit from moth and scale equalled fifty thousand dollars, and the work of the codling moth and the apple scab throughout the Willamette valley is so bad that not one-tenth of the apples are marketable. I believe it a very moderate estimate of the loss in this State this year from scale, moth and scab to place it at one hundred and fifty thousand dollars.

"The limited amount of spraying was a great surprise to me. *I am firmly convinced that two-thirds of the orchards now bearing good fruit will be worthless within five years because of failure to spray.*"

WILL SPRAYING PREVENT THIS LOSS.

Nearly everyone is aware of the serious losses caused by the ravages of insects and fungi, but all are not convinced that spraying will prevent this loss. Some are skeptical because they have sprayed their trees and have seen no beneficial results, but most are skeptical because it is easier to doubt and lose their fruit than it is to dispel their doubt and save their fruit by an intelligent use of the spray pump.

It is generally admitted that eastern fruit growers may use the spray pump advantageously, and that even in this State experimental spraying may be successful. The belief seems to be quite general, however, that our excessive rainfall during the spring months is an important factor in making spraying on a large scale ineffectual in this State. I have therefore thought best to supplement our own experience with that of a few prominent fruit growers in various parts of Oregon.

Mr. C. E. Stewart, of Medford, one of the most extensive growers of apples and pears in Oregon, writes as follows:

"I have failed to make a memorandum of dates but sprayed just as soon as the blossoms dropped from the fruit and *before*

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the calyx closed. The second spraying was three weeks after the first and the third spraying three weeks after the second. (This last spraying did little good as a heavy rain washed most of it off). The fourth spraying was commenced July 5th.

"Up to this time there was no wormy fruit in the orchard, but about the 20th I found some worms and many eggs on the outside rows on three sides of the orchard. Put in one day spraying them. The result was that at picking time the Bartletts, Howells, Clairgeaus and Winter Nelis were practically clean, there being not more than one-half of one per cent. wormy *except on three Bartlett trees on which the first spraying was omitted* to test the value of early treatment, but which were sprayed like the others the balance of the season. The fruit on these three trees at picking time was fully fifty per cent. wormy.

"I tried the same experiment on apples during the summer of 1896 with the same result. The per cent. of apples saved this year is fully ninety-five, and the loss nearly all occurred on outside rows where the moths came in from unsprayed orchards.

"I have a young apple orchard of eleven acres that commenced bearing last season and which was not sprayed. It is three-fourths of a mile from the main orchard and one-half mile from any bearing apple or pear trees. The fruit in this orchard was nearly all wormy. I took thirty-two wormy apples out of forty-eight from one tree in July.

"The spray I used this season and last consisted of one-half pound of Paris green, one-half pound of London purple, and four or five pounds of lime to one hundred and sixty gallons of water for the first two sprayings. For the third and fourth sprayings, fourteen ounces of Paris green and London purple were used with the same amount of lime and water as for the first sprayings. This solution may appear too strong for the last treatment, but if it is kept thoroughly stirred, *which is imperatively necessary to obtain good results*, it will injure neither fruit nor foliage.

"I think that as a rule three sprayings are sufficient if rain does not interfere and if there are no neglected orchards near."

Mr. A. Holiday of Scappoose sent us the samples of sprayed and unsprayed apples (See plate I), and wrote as follows:

"The unsprayed apples were gathered from old trees that have never been sprayed, and I think it safe to say that five-sixths of

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the apples were affected with scab. The sprayed fruit was taken from trees eight or nine years old that have had good care. Having never sprayed for scab alone, last spring just before the buds opened we gave the trees a spraying with Bordeaux mixture and the result was we had very little fungus, where the year before some of the fruit was badly affected.

"We paid one dollar per barrel for lime and five dollars per hundred for blue vitriol which made the cost of material about one and one-half cents per gallon. Two gallons of spray will cover quite a large tree, and when we take into consideration that at present nice smooth apples will bring one dollar per box, while inferior stock finds slow sale for less than half that amount, I think it pays to spray."

Mr. J. M. Wallace who has extensive apple and pear orchards near Salem and who closely followed our advice in spraying adds the following testimony:

"I sprayed our pears three times with the Bordeaux mixture. The two last times I added Paris green to the Bordeaux for codling moth. The spraying was a decided success. My pears were clean, free from spots, clear of fungus and in the market sold at the top price.

"Our Spitzenburg orchard of 2,700 trees we did not spray for the codling moth as our foreman thought there were not enough apples on the trees to justify the expense. There were, however, three or four hundred bushels, out of which we got 30 boxes free from worms, which sold for one dollar per box. The remainder we sold at the cider mill for thirty cents per bushel. This experience speaks for itself."

FAILURES.

The above examples are sufficient to prove that spraying is a success if intelligently and energetically done, even in Oregon. Still, many have sprayed, have seen no beneficial results from the application and have condemned the process as worthless. To such we would say study thoroughly the cause of your failure and then try again. Blame yourself for your failure—do not condemn a process that has been proven to be a success by thousands of practical men in most of the principal fruit growing regions of the world. The cause of your failure was probably one of the following causes:

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1st. The use of the wrong remedy.
2d. The use of poor materials.
3d. Lack of thoroughness in spraying.
4th. Spraying at the wrong time.
5th. Failure to spray often enough.

We will briefly consider each of these points in succession.

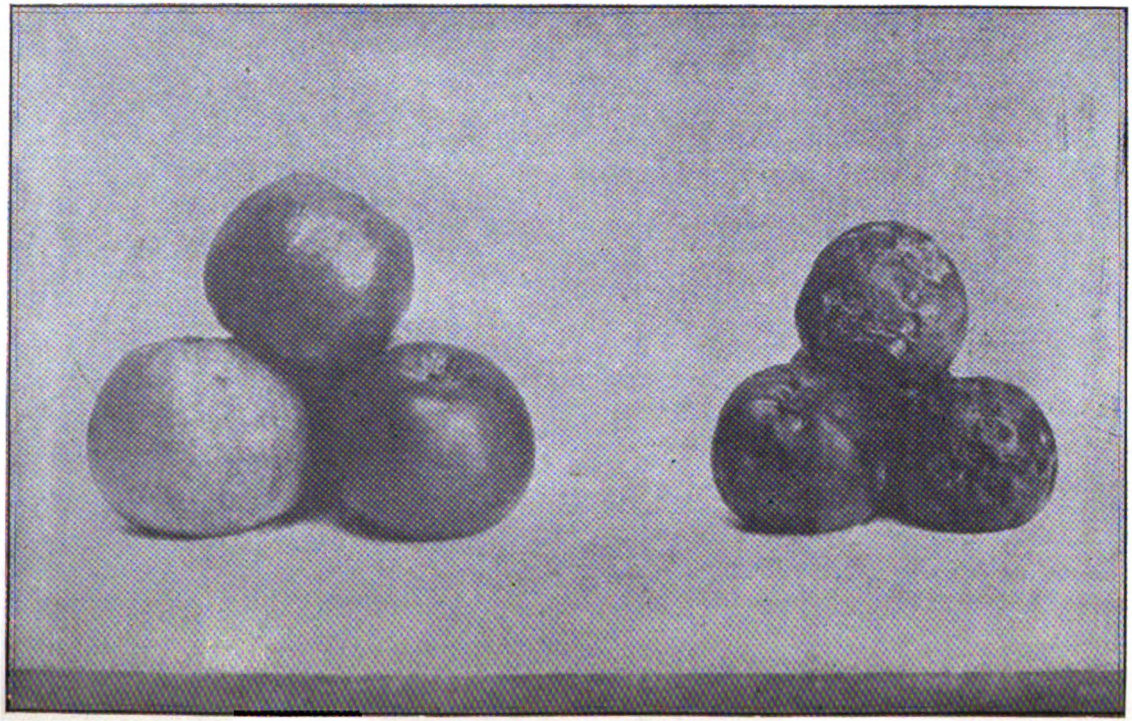
First. Do not spray because spraying in general is a good thing or because some one has succeeded in saving their crops by spraying. Study the pests infesting each variety of fruit in your orchard and then apply the proper remedies for those particular pests. Do not go into your orchard with a spray pump until you know why you are to spray, what you should use, and how best to apply it. In case of doubt on any of these points apply to the Station for further information.

Second. Unfortunately, much of the materials used in spraying is adulterated, and will give poor results no matter how thoroughly and intelligently they are used. This is really a serious matter since one not only loses the amount paid for the materials, but loses the expense incurred in applying the sprays, may lose a large portion of his crops, and is likely to lose his faith in all spraying operations. The fruit growers of the State should unite in securing the passage of a law imposing a heavy fine for the sale of any adulterated spraying materials. All that can be done at present is to require a guarantee that the materials are reasonably pure, and in case of doubt to send samples of the material to the Station for analysis.

Third. Slipshod work in spraying can not be too strongly condemned, and yet it is very common. Last season I passed some trees, not far from the Station buildings, that had recently been sprayed with Bordeaux mixture and on which the marks of careless work were everywhere apparent. Instead of being covered uniformly with a delicate blue tint, these trees looked as though a fresco painter had attempted to paint designs in blue upon their green foliage. Not more than one-half of the leaves had been touched by the spray. "Squirting a few quarts of water upon a tree as you hurry past is not spraying. A tree is honestly sprayed when it is wet all over, on all the branches and on both sides of the leaves. An insect or fungus is not killed until the poison is placed where the pest is. Bugs do not search for poison." Thoroughness in spraying then consists in getting the

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SPRAYED. UNSPRAYED.

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mixture evenly distributed over every part of the tree. It is not necessary to drench the tree. That is a needless waste of material. Two or three gallons of the mixture are sufficient to thoroughly spray a fully grown apple tree. The important point is to get it evenly distributed.

Fourth. Unfortunately, it is impossible to give definite directions regarding the time to spray, because that varies with the locality, with the season, with the varieties to be sprayed, and with the pests for which one sprays. However, under the head of insects and diseases and in a spraying calendar appended to this bulletin we shall indicate the approximate times at which the principal sprays should be applied. It is well to remember, however, that spraying for the codling moth and for most fungus diseases is preventive and must be applied before the pest has made much appreciable headway. It is also well to remember that it is not best to spray trees when they are in blossom. It is not necessary, and it is not only liable to injure the blossoms but is certain to poison many of the fruit growers' best friends—the bees. Another point to be kept in mind is that the spraying *must be done at the proper time.* If done a few days too early or too late it is likely to be entirely useless, whereas the same application if made at the right time would have been entirely satisfactory. When the time for spraying comes nothing should be allowed to interfere with it. Even cloudy or rainy weather should not cause a delay for any considerable time because nearly all the mixtures, if well prepared, and if they have a short time to dry will remain upon the trees through several heavy showers. After long heavy rainstorms, however, it is usually necessary to repeat the application.

Fifth. There are, it is true, some pests that may be controlled by one or two sprayings, but the vast majority of the really serious enemies of our fruit trees require three, four, and perhaps five applications to keep them under perfect control. In general no one should expect to make less than three or four applications.

THE SPRAYING OUTFIT.

In order to apply any spraying mixture thoroughly and economically to every part of a tree, one must use a good pump and good nozzles. It is impossible to recommend any exact style of pump that is best for all purposes. If one has but a few trees to

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spray almost any of the numerous styles of bucket pumps will answer the purpose. But for orchard work the pump should be large enough, and should have an air chamber sufficient to maintain a steady spray from several nozzles. All of its parts that come in contact with the liquid should be non-corrosive, it should be strongly built, simple in construction, easily taken apart for repairs and should have the pipes so arranged as to prevent clogging. It should be provided with an agitator which will keep the mixture well stirred and should be provided with couplings for at least two lines of hose. Several styles of pumps that will approximately meet the above requirements are upon the market and when mounted upon a suitable tank, and provided with two leads of hose, bamboo extension rods—for elevating the nozzles—and good nozzles, most of them will give good results. The best nozzle in our estimation is the Vermorel. For rapid work we prefer the double Vermorel and would select that form having a joint between the nozzle chamber and elbow to facilitate cleaning in case of clogging. The Vermorel nozzle throws a very finely divided spray and is suitable for nearly all purposes except the spraying of very tall trees. For such purpose some graduating nozzle like the McGowan is to be preferred. The form of tank, like the style of pump, depends upon the work to be done. If only a few trees are to be sprayed a small pump mounted on a barrel will make a convenient outfit, but if an orchard of any considerable size is to be sprayed the pump should be mounted upon some such tank as that shown in the accompanying plate—one that will hold 250 to 300 gallons of mixture. Such a tank will effect a saving in time, sufficient to more than cover its cost, in a single season. Steam spraying outfits are being introduced for use in large orchards and it is claimed for them that they are more economical than the hand power machines.

INSECTICIDES.

For all practical purposes insects may be divided into two great classes.

a. Those that actually chew and swallow the tissue of the plant or its fruit.

b. Those that pierce the surface of the plant with a long slender beak and suck up its juices, but eat none of the tissues.

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To class "*a*" belong all caterpillars, beetles, slugs, codling moth, etc.

To class "*b*" belong the green aphis, the woolly aphis, the various scale insects, squash bugs, and other true bugs, the red spider, etc.

The injury caused by insects of class "*a*" is readily observed and hence is more apt to receive prompt attention, while on the other hand the injury caused by those of class "*b*," although no less severe, is often less noticeable. Hence it is that insects of this class, which injure the plant simply by appropriating its juices, thus causing the foliage to become spotted or yellow, and finally to wither and die, are allowed to multiply to such an extent that the most energetic measures are required for their control.

A brief consideration of the above facts regarding the general habits of insects, will serve to convince one that while most insects belonging to class "*a*" are readily destroyed by the poison sprays, on the other hand, insects belonging to class "*b*" are but little if at all affected by them, since they secure their food beneath the surface of the leaf and hence can not be made to eat any of the poison. It thus becomes necessary in order to successfully deal with these two classes of insects, to have two general classes of insecticides.

1st. The poisons, as Paris green and London purple, which are to be used against insects of class "*a*," but which are practically of no value against those of class "*b*."

2d. Those substances which kill by contact, as kerosene emulsion, the resin wash, the lime, salt, and sulphur mixture, whale-oil soap, lye, sulphur, etc., which are chiefly used against insects of class "*b*."

POISONS.

The chief insecticides of this class are Paris green and London purple. These are so well known that but few words concerning them are necessary. Paris green is, we think, undoubtedly the better of the two. It is more uniform in strength, kills more quickly, and is less liable to burn the foliage. London purple is slightly cheaper, and, being lighter, is more easily kept from settling to the bottom of the spraying tank. For use against the codling moth, caterpillars, and most other insects of class "*a*," apply either, in the form of a spray, using the following proportions:

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SPRAY NO. 1.

Paris green or London purple	1 pound.
Unslaked lime	2 pounds.
Water	160 to 200 gallons.

Slake the lime and while it is slaking stir in the Paris green. Then strain the mixture through a coarse sieve or piece of burlap, and dilute with the required amount of water. The Paris green and water can be used in the above proportion without the addition of the lime, but it is much safer to add it since it precipitates the soluble arsenic compounds, and thus prevents injury to the foliage. This is especially true in spraying such tender foliage as that of the peach.

If at any time, it is desirable to spray at the same time with an insecticide and a fungicide, and such is usually the case, either of the above poisons may safely be added to the Bordeaux mixture—the lime in the latter preventing all injurious effects of the poison upon the foliage.

On account of the price and the fact that Paris green and London purple are generally supposed to be adulterated, we receive frequent requests for information regarding the feasibility of using arsenic--arsenious acid—as a substitute. For this reason the following formula is given with the warning that it be used with caution, since, if any of the arsenic remains in solution instead of being precipitated by boiling with the lime, it is liable to injure the foliage:

SPRAY NO. 1*a*.

White arsenic	1 pound.
Lime, unslaked	2 pounds.
Water	3 gallons.

Boil together for at least an hour, and when ready for use dilute with 200 gallons of water, or preferably with Bordeaux mixture. We have used this preparation successfully but find that considerable care is necessary to prolong the boiling until all of the arsenious acid is precipitated as insoluable arsenite of lime.

CONTACT INSECTICIDES.

SPRAY NO. 2—KEROSENE EMULSION.

We consider this one of the best insecticides to use against insects of class "*b*." Kerosene kills by contact and its penetrating power is such that but few insects can resist it. The pure oil is,

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however, about as injurious to plants as to insects, and thus it becomes necessary to emulsify it with some substance that it may readily be diluted with water. Soap or sour milk are the best of such substances. The emulsion with soap is made as follows:

Water	1 gallon.
Soap (preferably whale-oil soap)	½ pound.
Kerosene oil	2 gallons.

Dissolve the soap in the water by boiling. Add the suds, still boiling hot, to the oil and violently agitate the mixture by pumping it back upon itself through a force pump. If hot, the emulsion should form in about five minutes, otherwise it may not emulsify at all without reheating. A perfect emulsion should have a creamy appearance, and should adhere to the surface of glass without oiliness. If not perfect, the oil will rise to the surface and much harm may result, especially if the emulsion is used as a dip for nursery stock or animals. Such an emulsion may be used immediately; or, if well made may be kept indefinitely as a stock mixture to be diluted and used as wanted.

When ready for use, dilute the required amount of stock emulsion with 8 to 15 or 20 times its bulk of water, and use as a spray. The stronger mixture applied in the fall, has been found effective in destroying the pear-leaf blister mite. The weaker will be found sufficiently strong to destroy the young of the oyster-shell scale, if applied to infested trees just after the blossoms fall, and will also prove effective in destroying green aphis, woolly aphis, and red spider, if applied at any time when they are observed to be abundant.

While recommending the above emulsions, I am well aware that, in the past, they have not been the favorite sprays with Oregon fruit growers, but I still believe that careful and more extensive use of properly made emulsions will yet demonstrate that they are among the best, if not the best washes we have for controlling the above mentioned class of insects.

One of the chief objections urged against these emulsions is their cost, and yet when we consider the ease with which they are made and their effectiveness, we must, notwithstanding the exorbitant price of kerosene oil, still number them among our cheapest effective washes. Two gallons of kerosene and one gallon of strong suds will, in process of emulsifying, increase in volume to about four gallons of stock emulsion, which when diluted with

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water in the above indicated proportions will make from 32 to 80 gallons of spraying strength—the latter thus costing (at the present price of kerosene) from about 1¼ cents down to ½ of a cent per gallon.

It it also urged against kerosene emulsion that it cannot be safely used in this climate—that it will kill the trees. My experience has been that it can be as safely used here as anywhere else. All that is necessary to safely use this remedy is to strictly follow directions in making the emulsion, dilute it as directed before applying it, and then *see that it does not run down the trunk of the tree and collect in the "cup" of earth about the crown.*

SPRAY NO. 3—RESIN WASH.

This is a favorite wash in California for several of the scales infesting citrous fruits. In this State its chief value is as a spray for the various kinds of plant lice. For this purpose it may be used as a substitute for kerosene emulsion with good results, particularly in the dry summer months. It can also be used as a summer spray for San Jose scale, but we do not advise such use since summer sprays are of but little value against this insect. The resin wash may be made as follows:

Resin	20 pounds.
Crude caustic soda (78 per cent.)	5 pounds.
Fish oil	2½ pints.
Water to make	100 gallons.

Place the resin, soda, and oil in a kettle with sufficient water to cover them to a depth of three or four inches. Boil about two hours, making occasional additions of water, or until the compound resembles very strong black coffee. Dilute to one-third the final bulk with hot water, or with cold water added slowly over the fire, making a stock mixture which must be diluted to the full amount of 100 gallons when ready for use.

SPRAY NO. 4—LIME, SULPHUR AND SALT.

This is a winter wash and is by far the most satisfactory remedy for the San Jose scale that we have tested. It should never be applied to trees after the buds have opened in spring.

Several methods of preparing it are in use, but the formula that seems to give the best results is based upon the extensive experience of Mr. Emile Schanno, Horticultural Commissioner for the Fourth District. It is as follows:

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Lime (unslaked)	50 pounds.
Sulphur	50 pounds.
Salt	50 pounds.
Water	150 gallons.

Slake the lime, add the sulphur, cover with water and boil briskly for at least one hour, or until the lime and sulphur are completely dissolved. Then add the salt and continue to boil for fifteen or twenty minutes. When ready for use dilute to one hundred and fifty gallons.

The best results are obtained with this wash if it is applied, while still warm, with considerable force in the form of a coarse spray.

A mixture somewhat similar to the above is made by using seven or eight pounds of copper sulphate in place of the fifty pounds of salt. It originated in the work of the State Board of Horticulture and gives most excellent results when used as a winter spray.

Both of the above mixtures are difficult to properly prepare and unless one has ample facilities for the work greater satisfaction will be obtained by purchasing the prepared sprays than by attempting to make them oneself. The lime, sulphur and salt is sold as Spray No. 1, and the lime, sulphur and copper sulphate as Spray No. 2, by David M. Dunn & Co., Portland, Oregon.

SPRAY NO. 5—BORDEAUX MIXTURE.

This is perhaps the most generally useful of all the spraying mixtures. It is the principal remedy for fungus diseases, and also has some value as an insecticide. It also has a beneficial effect upon plants which is independent of its effect upon fungus and insect parasites, and is the best medium in which to apply Paris green or London purple. In fact, had it no value as a fungicide or insecticide, I am strongly of the opinion that its beneficial effect upon plants and its value as a medium in which to apply the arsenites would justify me in recommending that *bordeaux mixture be made the basis of all sprays containing the arsenites. i. e.*, bordeaux mixture should be used instead of pure water in preparing Spray No. 1.

Bordeaux mixture is ordinarily made as follows:

Copper sulphate	6 pounds.
Lime (unslaked)	4–6 pounds.
Water	50 gallons.

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For winter spraying in those portions of the State that have excessive rainfall it has been found best to use eight to ten pounds of lime.

So much depends upon the correct preparation of bordeaux mixture that we quote in full the directions for its preparation which are given by Dr. Galloway of the United States Department of Agriculture:

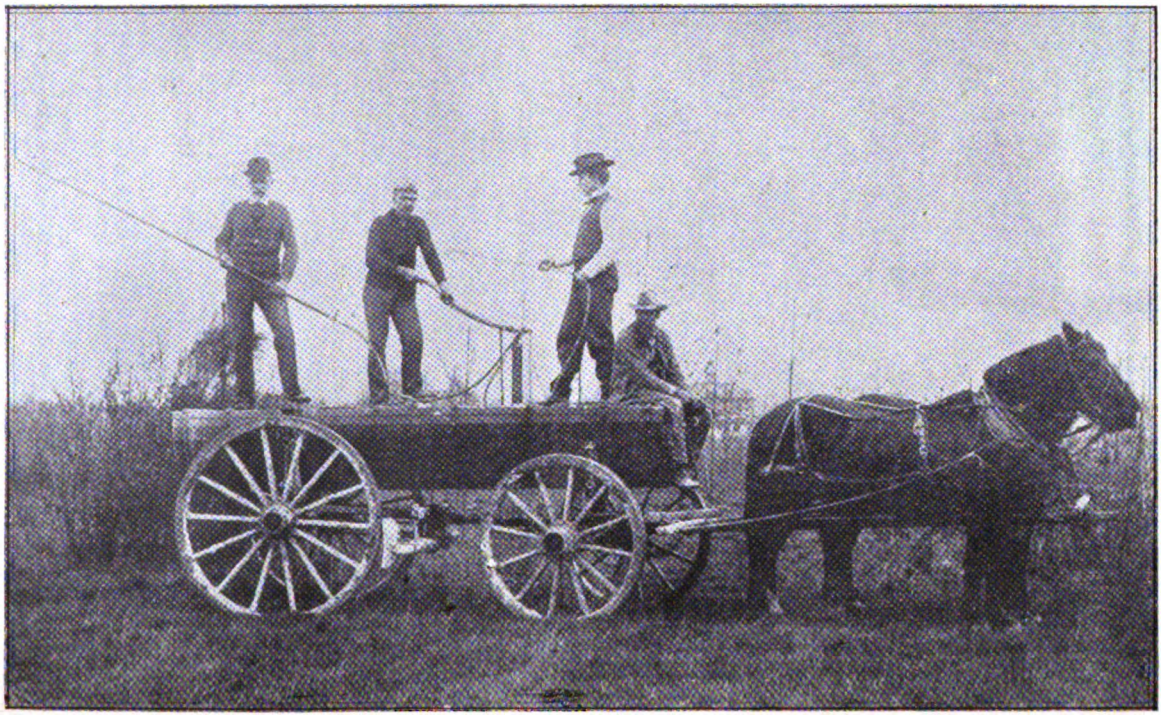
"It has been found that the method of combining the ingredients has an important bearing on both the chemical composition and physical structure of the mixture. For example, if the copper sulphate is dissolved in a small quantity of water and the lime milk diluted to a limited extent only, there results, when these materials are brought together, a thick mixture, having strikingly different characters from one made by pouring together weak solutions of lime and copper sulphate. It is true, furthermore, that if the copper sulphate solution and lime milk are poured together while the latter or both are warm, different effects are obtained than if both solutions are cool at the moment of mixing.

"Briefly, the best results have been obtained from the use of the bordeaux mixture made in accordance with the following directions: In a barrel or other suitable vessel place 25 gallons of water. Weigh out 6 pounds of copper sulphate, then tie the same in a piece of coarse gunny sack and suspend it just beneath the surface of the water. By tying the bag to a stick laid across the top of the barrel no further attention will be required. In another vessel slack 4 pounds of lime, using care in order to obtain a smooth paste, free from grit and small lumps. To accomplish this it is best to place the lime in an ordinary water pail and add only a small quantity of water at first, say a quart or a quart and a half. When the lime begins to crack and crumble and the water to disappear add another quart or more, exercising care that the lime at no time gets too dry. Toward the last considerable water will be required, but if added carefully and slowly a perfectly smooth paste will be obtained, provided, of course, the lime is of good quality. When the lime is slacked add sufficient water to the paste to bring the whole up to 25 gallons. When the copper sulphate is entirely dissolved and the lime is cool, pour the lime milk and copper sulphate solution slowly together into a barrel holding 50 gallons. The milk of lime should be thoroughly stirred before pouring. The method described insures good mixing, but to complete this work the barrel of liquid should receive final stirring, for at least three minutes, with a broad wooden paddle.

"It is now necessary to determine whether the mixture is perfect—that is, if it will be safe to apply it to tender foliage. To

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